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16. Abstract (Limit: 200 words) The Illinois Environmental Protection Agency was one of a number of agencies which participated in the United States Environmental Protection Agency's Nationwide Urban Runoff Program (NURP). NURP consisted of 28 projects which evaluated the type and extent of urban runoff problems, impacts of urban runoff on receiving waters and the effectiveness of control practices. The work conducted by the IEPA evaluated the effectiveness of municipal street sweeping in influencing urban runoff quality and to assess the impact of urban runoff on an agricultural receiving stream.

The work reported in this document is the component of the study which assessed the impacts of urban runoff on the receiving stream. The objective of this study was to evaluate the effects of urban runoff on the biota of both the urban receiving stream, Boneyard Creek, and the agricultural stream into which it flows, the Saline Branch Drainage Ditch. This study was to determine whether there were differences in the composition of fish and macroinvertebrate communities upstream and downstream of the urban area and where possible to determine whether these differences could be attributed to urban runoff. Fish and macroinvertebrate communities were sampled upstream and downstream from Champaign-Urbana area. Macroinvertebrates were also collected in the urban stream Boneyard Creek. Chlorophyll samples were collected upstream and downstream of the urban area.

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NATIONWIDE URBAN RUNOFF PROJECT, CHAMPAIGN, ILLINOIS:
The Biological Impact of Urban Runoff on the Saline Branch Drainage Ditch and Boneyard Creek

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EXECUTIVE SUMMARY

The impact of urban runoff on water quality has been studied extensively during the last decade. One major study was recently completed under the U.S. Environmental Protection Agency's Nationwide Urban Runoff Program (NURP). NURP consisted of 28 projects which evaluated the type and extent of urban runoff problems, impacts of urban runoff on receiving waters and the effectiveness of control practices. The Illinois Environmental Protection Agency (IEPA) was awarded a grant to complete one of the 28 projects. The Illinois State Water Survey was contracted by the Agency to evaluate the effectiveness of municipal street sweeping in controlling urban runoff quality and to assess the impact of urban runoff on an agricultural receiving stream. The work reported in this document is a component of the study which assessed the impacts of urban runoff on the receiving stream. The objective of this portion of the study was to evaluate the effects of urban runoff on the biota of both the urban receiving stream, Boneyard Creek, and the agricultural stream into which Boneyard Creek flows, the Saline Branch Drainage Ditch.

The intent of the study was to determine whether there were differences in the composition of fish and macroinvertebrate communities upstream and downstream of the urban area and where possible to determine whether these differences could be attributed to urban runoff. Fish and macroinvertebrate communities were sampled upstream and downstream from Champaign-Urbana area. Macroinvertebrates were also collected in the urban stream Boneyard Creek. Chlorophyll samples were collected upstream and downstream of the urban area.

Fish and macroinvertebrate data from a study completed by Heidinger et al. (1983) was also analyzed to determine population trends. The Heidinger study was conducted during the same time period as the IEPA study. Fish and macroinvertebrate populations were monitored in the Saline Branch Drainage Ditch from November 1979 - February 1983.

Conclusions of the study are:

1) There were no significant differences in the species composition or the number of fish upstream and downstream of the urban area. Urban runoff does not appear to effect the composition of the fish community in this stream.

2) There were differences in the species composition of macroinvertebrates among the three Saline Branch Drainage Ditch sites as well as in Boneyard Creek. However these differences cannot be attributed to urban runoff alone and the degree to which urban runoff is affecting the species composition cannot be determined without additional toxicity studies.

3) The Urbana-Champaign Northeast Sewage Treatment Plant appeared to be the major factor influencing the macroinvertebrate species composition at sites downstream from the urban area and the Sewage Treatment Plant. There was a dramatic increase in the number of Turbellaria (flat worms) and Annelida (round worms) as well as a dramatic decrease in the diversity of Ephemeroptera (mayflies) at

this site as compared to control site 1 and site 4 which was downstream of the urban area but upstream from the Urbana-Champaign Sanitary District Sewage Treatment Plant. Data collected by Heidinger et al. confirm this observation.

4) Site 4, downstream of the urban area but upstream of the Sewage Treatment Plant, showed a trend toward more pollution tolerant species but does retain a good diversity of Ephemeroptera (mayflies). Physa sp. which are prevalent in Boneyard Creek are common at this site indicating an urban influence. The impact of storm water runoff alone in determining this distribution could not be determined by sampling methods utilized in this study.

5) Macroinvertebrate numbers and diversity were quite low at both sites on Boneyard Creek. Physa sp., Oligochaeta or Chironomidae make up 95% and 98% of the species composition at Site 2 and Site 3 respectively.

INTRODUCTION

Urban stormwater was identified as a non point source of water pollution in the 208 water quality plans of many agencies nationwide. However, no study had demonstrated that pollutants in urban runoff, without the combined effects of point sources and combined sewer overflows (CSO), resulted in long term water quality or biological impacts in urban streams. Consequently the USEPA initiated the Nationwide Urban Runoff Program (NURP) in 1978 which funded 28 projects to assess the nature, cause, impact, and control of urban runoff pollution.

The Illinois Environmental Protection Agency (IEPA) was selected to conduct one of the 28 NURP projects. Most of the work was sub-contracted to the Illinois State Water Survey (ISWS) which conducted a two phase study. The first phase of the study evaluated the effectiveness of streetsweeping as a Best Management Practice for controling water pollution from urban runoff (Terstriep et al. 1982). The purpose of this study was to determine whether urban runoff from Champaign-Urbana impacts the biological composition of the urban stream Boneyard Creek and its agricultural receiving stream Saline Branch Drainage Ditch. The results of water quality and quantity impacts are contained in the report Nationwide Urban Runoff Project, Champaign, Illinois: Assessment of the Impact of Urban Storm Runoff on an Agricultural Receiving Stream (Bender et al. 1983). The results reported in this paper are a component of the study to assess the impacts of urban runoff on receiving streams.

This paper contains the results from the ecological surveys on fish and macroinvertebrates that were completed in the fall of 1981 and the fall of 1982. This paper also contains an assessment of fish, macroinvertebrate and phytoplankton data collected by Heidinger et al. (1983) in the Saline Branch Drainage Ditch between November 1979 - March 1982. Finally diurnal oxygen measurements taken in the fall of 1982 are discussed.

LITERATURE REVIEW

There have been numerous studies which identify urban stormwater runoff as a source of pollution in receiving streams throughout the United States. Papers which have examined actual ecological and biological impacts on streams are scarce. Porcella and Sorenson (1979) reviewed 1200 reports on urban stormwater. Of these only 2% pertained to ecological impacts. Fourty percent of the papers pertained to the modeling of stream hydrology and hydraulics, 35% dealt with urban runoff measurements and 23% applied to water quality measurements in streams.

Very few of the biological impact studies address the direct toxicity of nutrients, heavy metals or pesticides on the biota (Rice 1983). Most papers are ecological surveys which relate parameters such as total number of organisms, type of taxa, diversity and relative abundance to water quality in urbanized versus nonurbanized portions of creeks. Many

such studies have noted a reduction in total number and diversity of both fish and macroinvertebrates as well as a predominance of pollution tolerant species in urban reaches of streams (Pitt and Bozeman 1982 and 1980, Brown and Green 1980, Porcella 1980, DiGano 1976 and 1975 and Ragan and Dietman 1975).

However one must be cautious when implying cause and effect relationships between urban runoff and receiving water (Pitt 1984). Heaney et al. (1980) found that many of the studies reviewed did not separate the effects of urban runoff from other factors such as leaks from sanitary sewers, combined sewer overflows or habitat degradation resulting from channel modification. A review of fish kill data (Heaney et al. 1980) indicates that of fish kills reported between 1970-1979 less than 3% could be attributed to urban runoff. As Rice (1983) indicates, additional data need to be collected for both site specific and general situations before predictions concerning biological effects can be made. Rice (1983) suggested that additional work must be completed in the areas of synergistic effects of combined pollutants upon receiving stream organisms, the effects of pulse loading, the bioavailability of sediment associated pollutants, the mobility of pollutants in sediments in varying conditions and the food chain dynamics associated with urban runoff pollutants.

STUDY AREA

The study area is in Champaign County which is located in east central Illinois (see Figure 1). This area is part of the Bloomington Ridged Plain within the till plain section of the Central Lowland Province (U of I 1974). The average annual precipitation is 36.5 inches. Three major streams, the Kaskaskia, the Embarras and the Vermilion, have their headwaters in this vicinity.

The last glacier deposited an average of 200 feet of glacial drift throughout the county which has been covered with 40-60 inches of loess. The major soil type developed on these till plains is the Drummer-Flanagan Association which consists of nearly level, poorly to somewhat poorly drained silty soils (U of I. 1974). The surface soil is a silty clay loam 8-14 inches thick, and the subsoil is a mixture of various silty clay loams 31-33 inches thick.

Land use in the area is mainly agricultural with soybeans and corn being the predominant crops. Urban areas consist of the cities of Champaign, Urbana and adjacent housing developments. The major components of land use are: Residential, commercial, limited industrial and the University of Illinois. (U of I. 1974, USDA 1982).

The combined population of Champaign and Urbana is approximately 100,000. Separate sanitary and storm sewer networks serve the entire urban area of 14 square miles. Storm runoff from about 60% of the urban area enters Boneyard Creek. The Creek is 3.5 miles long with an mean

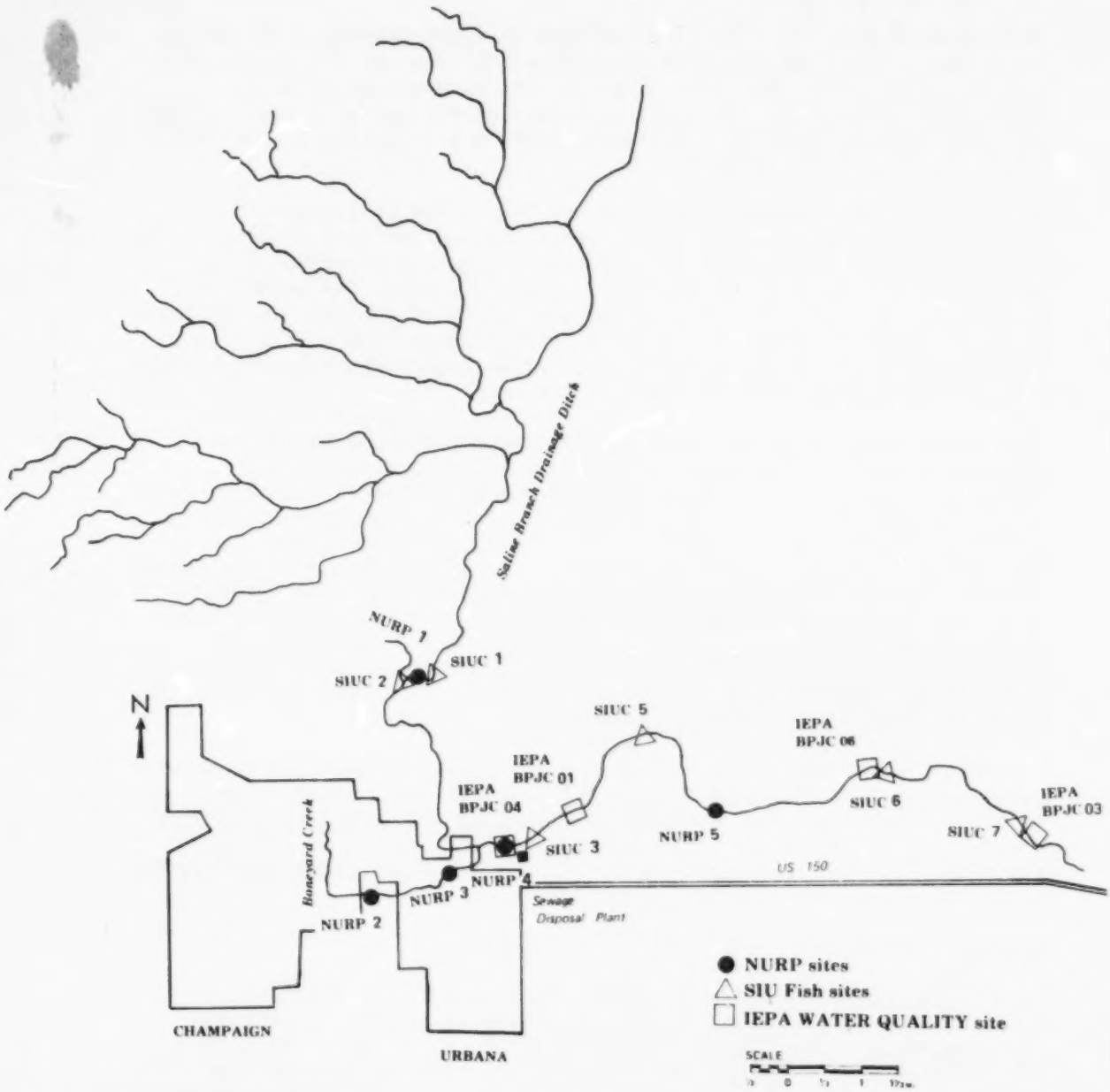

Figure 1. National Urban Runoff Project (NURP) Study Area in Champaign, Illinois. Sites indicated on the map are: NURP sites, Southern Illinois University at Carbondale fish and macroinvertebrate sites and IEPA Ambient Water Quality Sampling Stations. BPJC indicates that the IEPA stations are on the Saline Branch of the Salt Fork of the Vermilion River in the Wabash River Basin.

daily flow of 4.5 CFS. The flow declines to approximately 1 CFS during the summer. The Creek has been channelized for most of its length with approximately 25% of the Creek diverted into underground culverts. Substantial portions of the banks have been stabilized with sheet piling and other manmade material. Boneyard Creek is a tributary of the Saline Branch Drainage Ditch (Figure 1).

About 80% of the wastewater generated in the cities is conveyed to northeast treatment works of the Urbana-Champaign Sanitary District. The plant utilizes a combination of activated sludge and trickling filter operations and has a design average flow of 17.3 MGD. The waste load treated at the plant has a population equivalent of 90,000. The effluent is 81.8% domestic sewage and 18.2% industrial waste (Lewis et al. 1981). The plant effluent is delivered to the Saline Branch Drainage Ditch about 0.5 mile downstream from the mouth of Boneyard Creek.

The Saline Branch Drainage Ditch is a thoroughly channelized stream draining an agricultural area of 51 square miles upstream from Champaign-Urbana. As it passes through Urbana the Saline Branch Drainage Ditch receives incoming flows from Boneyard Creek, the Urbana-Champaign Sanitary District Sewage Treatment Plant and a few minor urban sources. The average flow upstream of the cities is 15 CFS, upstream of the sewage treatment plant is 25 CFS and at NURP Site 5 is 50 CFS. The bottom of the Creek is sandy with gravel predominanting in some areas. The banks of the stream are quite steep as a result of channelization and are covered by a mixture of trees, shrubs and grasses. Dominant species vary from site to site. The Saline Branch Drainage Ditch joins the Salt Fork of the Vermilion River about eight miles east of Urbana.

Five sites along the Saline Branch Drainage Ditch and Boneyard Creek were sampled during storm events between October 1981 and September 1982. One site was located upstream from Champaign-Urbana and served as a control. Two sites were located on the urban stream, Boneyard Creek, and two additional sites were located on the receiving stream downstream from the cities to assess the impact of urban runoff.

SITE DESCRIPTION

Site 1, the control station on Saline Branch Drainage Ditch, was 3.6 miles upstream of the mouth of Boneyard Creek at a county road bridge (see Figure 1). The site drains approximately 50.8 square miles of agricultural land. The Village of Thomasboro lies in the upper end of the wastershed (Bender et al 1983). The banks are steep and covered with grasses. Trees line the banks particularly upstream from the bridge. The stream bottom is mainly sand with some silt, with pieces of concrete and brick scattered along the bottom.

Site 2 is located on Boneyard Creek (Figure 1). This site has a drainage area of 3.1 square miles most of which is in the City of Champaign. The Central business district of Champaign makes up 7.5% of the drainage area

and is nearly 100% impervious (Bender et al. 1983). Residential, commercial and light industrial properties make up 81.2% of the basin and measure 35% impervious (Bender et al. 1983). The stream banks and channel have been modified and stabilized with a layer of fabric.

Site 3 is also located on Boneyard Creek at the Broadway Avenue bridge in Urbana (Figure 1). The drainage area is 4.86 square miles at this point. Urbana's central business district makes up 31% of the additional 1.76 square miles of drainage area (Bender et al. 1983) which is essentailly 100% impervious. Other City properties account for 94.5% of the additional drainage area and are 35% impervious (Bender et al. 1983). There is a distance of 3.5 miles between Sites 2 and 3 (Bender et al. 1983). The site is channelized and has steep grass and weed covered banks. Commercial buildings are located within 100 feet of the stream's edge, sand and gravel along with broken brick and concrete blocks comprise the stream bottom.

Site 4 is 0.3 miles down stream on the Saline Branch Drainage Ditch from the mouth of Boneyard Creek and 3.9 stream miles downstream of Site 1 (see Figure 1). This site is 50 feet upstream from the Urbana-Champaign Northeast Sewage Treatment Plant. The lateral drainage upstream from this site not included in NURP sites 1 and 3 is approximately 9.4 square miles (Bender et al. 1983). The stream has wooded banks, a sand and gravel bottom and a concrete weir marking the abandoned USGS gauge station.

Site 5 is located 4 miles downstream of the Urbana-Champaign STP on the Saline Branch Drainage Ditch (Figure 1). Lateral drainage adds 7.5 square miles including 3.9% City property and 96.1% urban fringe (Bender et al. 1983). The stream is channelized at this site, has steep grass and weed covered banks upstream of the site and wooded banks downstream from the site. A flat gravel and sand bottom along with some rocks and pieces of concrete comprise the aquatic habitat.

METHODOLOGY

Fish

Fish samples were collected at NURP Sites 1 and 5 on September 28, 1982 by the Illinois Department of Conservation in conjunction with the IEPA.

A 310 ft. (94.50 meters) segment of stream averaging 30 ft. (9.14 meters) in width was sampled at Site 1. Two applications of rotenone 56 oz. (4 ppm) and 32 oz. (2.3 ppm) were applied. At Site 5 a 310 ft. (94.50 meters) segment of stream averaging 50 ft. (15.24 meters) in width was sampled. Two applications of rotenone 62 oz. (4 ppm) and 31 oz. (2 ppm) were applied. Blocking seines with a mesh size of 1/4 inch (0.64 cm) were used.

Total number of fish collected, total weight, size class and percent of total number and percent of total weight were recorded for each species.

Additional information on fish populations was obtained from Heidinger et al. (1983) who sampled six sites on the Saline Branch Drainage Ditch from March 1982 - December 1982 (see Figure 1). Fish were collected by electrofishing with a 3 phase 230 volt Homelite generator.

Table 1. Maximum Constituent list for water quality hand held sample analyses collected during fish sampling on 9/28/82, macroinvertebrate sampling 10/28-10/29/81 and diel oxygen measuring on 9/8-9/9/82.

Constituent	Abbreviation	Units of Measure
Chlorophyll a (corrected)		ug/l
Chlorophyll a (uncorrected)		ug/l
Chlorophyll b		ug/l
Chlorophyll c		ug/l
pheophytin a		ug/l
Total Ammonia-N	NH3-N	mg/l
Total Nitrate plus Nitrite Nitrogen	NO2+NO3-N	mg/l
Total Kjeldahl - nitrogen	TKN	mg/l
Total phosphorus	P	mg/l
Dissolved phosphorus	P	mg/l
Calcium	Ca	mg/l
Magnesium	Mg	mg/l
Sodium	Na	mg/l
Potassium	K	mg/l
Barium	Ba	ug/l
Boron	B	ug/l
Beryllium	Be	ug/l
Cadmium	Cd	ug/l
Strontium	Sr	ug/l
Vanadium	V	ug/l
Zinc	Zn	ug/l
Hardness		mg/l as CaCO3
Chromium	Cr	ug/l
Copper	Cu	ug/l
Cobalt	Co	ug/l
Iron	Fe	ug/l
Total Mercury	Tot Hg	ug/l
Dissolved Mercury	Dis Hg	ug/l

Habitat Assessment

Habitat diversity data were collected in conjunction with fish sampling on September 28, 1982 at NURP sites 1 and 5. Eight transects of approximately 40 ft. (12.20m) intervals were run at both sites. The transects were started at the upstream end of each study segment.

Habitat type (pool, riffle and run), depth (ft.), stream velocity (ft/sec) and substrate type (see Table 2) were recorded at two foot increments across the transect at Site 1 and at four foot increments at Site 5 (see Table 2).

Velocity was measured with a Price AA Current meter.

Channel width was measured from the top of the right downstream bank to the top of the left downstream bank at the transect located furthest downstream.

Table 2. Substrate bottom types measured during habitat assessment.

Substrate	Particle Size
Silt-mud	<.062 mm
Sand	.062-2 mm
Gravel	2 - 64 mm (.08 - 2.5 inches)
Rubble	64 - 250 mm (2.5 - 9.8 inches)
Boulder	250 - 4000 mm (> 9.8 inches)
Bedrock	Solid Rock

Bottom Type
Claypan - compacted soil
Plant detritus
Vegetation
Submerged logs

Macroinvertebrates

Macroinvertebrate collections were completed by IEPA at all 5 NURP sites on October 28-29, 1981. Macroinvertebrates were hand collected for 40 minutes in 492 ft. (150 m) stream segments which encomposed the NURP sites. All habitats within the 492 ft. (150 m) were sampled to get a representative sample of species composition at each site. Water quality hand held samples were collected at all sites in conjunction with the macroinvertebrate stream sampling. Parameters sampled are listed in Table 1. Macroinvertebrates were keyed out using 4 manuals: Aquatic Insects of Wisconsin Volume II (Hilsenhoff 1975), Taxonomy and Ecology of Stenonema Mayflies (Heptageniidae: Ephemeroptera) (Lewis 1974), Larvae of the North American Caddisfly Genera (Trichoptera) (Wiggens 1977) and Freshwater Invertabrates of the United States of America Second Edition (Pennark 1978).

Benthic macroinvertebrates were collected by Heidinger et al. (1983) at 6 sites along the Saline Branch Drainage Ditch between March 1982 - December 1982 (See Figure 1). Heidinger et al. (1983) used Hester-Dendy artificial substrate samplers each of which had an area of approximately 144 sq. in. (929 sq. cm.) of surface for attachment of organisms. The samplers were placed so that they transected the middle of each 492 ft. (150 m) sample reach (Heidinger et al. 1983).

Water Quality

The Handheld large-mouth bottle method was used for sampling water quality during fish sampling on 9/28/82, macroinvertebrate sampling on 10/28-10/29/81 and diel oxygen measuring on 9/8-9/9/82. This method was chosen in accordance with the Illinois Environmental Protection Agency, Division of Water Pollution Control Field Methods Manual (IEPA 1984) which specifys use of this method for streams with velocities less than 2 ft/s when stream depth is equal to or less than 6 inches. Samples were analyzed for the constituents listed in Table 1.

The Illinois State Water Survey collected water quality samples using sigamotor model 6301 automatic sampler at all sites during dry weather between 9/81 and 9/82. Between 8 to 13 samples were taken at each site. Constituents analyzed for are listed in Table 15.

The Urbana Champaign Sanitary District (UCSD) sewage treatment plant is sampled daily. These are analyzed for TSS, NH3-N and BOD5. The Illinois State Water Survey collected wet weather samples using a Sigamotor model 6301 automatic sampler. Fifty-nine storm events were sampled. Constituents analyzed are listed in Table 16.

Bank Vegetation

Vegetation on the banks of all 5 NURP sites was identified during September of 1982. Plants were visually inspected for a distance of 246 ft. (75 m) upstream and 246 ft. (75 m) downstream of all sites. Plants were keyed using Gray's Manual (Fernald 1950) and Flora of Illinois (Jones 1971).

Diel Oxygen

Diel oxygen measurements were taken at NURP sites 1, 3, 4 and 5 on 9/8/82 and 9/9/82. Measurements were made with a Hydrolab Digital Water Quality Measurement System 4000 Series/Digital 4041. Measurements began at 2200 hours at station 1 on 9/8 and were taken approximately every two hours at Stations 1, 3, 4 and 5 until 2036 hours on 9/9. Water temperature, conductivity, and pH were also taken with the Hydrolab. Air temperature was taken with a Cole Parmer Instrument Company mercury thermometer.

RESULTS

Fish

Fish species collected between March and December 1982 are listed in Table 3. Relative abundance of species except those collected at SILC Site 6 are listed in Table 4. Site 6 was so morphologically different than other sites that it was excluded from analysis.

Karr's Index of Biotic Integrity (IBI) (Karr 1981), calculated for all SIUC and NURP Fish Sites, ranged from 33-36 indicating that fish communities in the entire study area are poor to fair. This is reflected by the predominance of water pollution tolerant species at all sites.

Cluster analysis and analysis of variance for the SIU data indicated that there was no significant difference at the .05 level for Karr's Biotic Integrity values, total number of organisms or species number between any of stations in the study area (Heidinger et al. 1983). Since only single fish samples were collected at the NURP sites, the data collected during that sample have not been analyzed statistically.

Duncan's Multiple Range Test indicated a significant difference at the .05 level in the species diversity between SIUC's Site 1 and Site 7 which is approximately 10 miles downstream from NURP Site 5. The mean number of species was 9 at Site 1 and 13 at Site 7.

Pimephales notatus (bluntnose minnow) was consistently the most abundant species at all sites. The only exception was at NURP Site 1 where Lepomis megalotis (longear sunfish) predominated. Data for this site must be viewed cautiously, however, because the site was sampled only once on 9/28/82.

Only SIUC Site 3 and NURP Site 1 had more than 3 species with an abundance of greater than 5% (Table 5).

Water Quality data for the two sites is listed in Table 6.

Table 3. Occurence and Distribution of Fishes in the Saline Branch Drainage Ditch Between March 1982 - December 1982*. Collected by Southern Illinois University using electrofishing techniques and the Illinois Department of Conservation using rotenone techniques.

ORGANISM	NURP Sites	SIUC Sites
Clupeidae (herrings)		
Dorosoma cepedianum (gizzard shad)	1	1, 2, 5
Esocidae (pikes)		
Esox americanus (grass pickerel)	5	2, 3, 5, 6, 7
Cyprinidae (minnows and carps)		
Campostoma anomalum (stoneroller)	1	1, 2, 3, 5, 7
Cyprinus carpio (carp)	1	1, 2, 3, 5, 7
Ericymba buccata (silverjaw minnow)		1, 2, 3, 5, 7
Nocomis biguttatus (hornyhead chub)		3, 5, 7
Notemigonus crysoleucas (golden shiner)	1	3, 5, 6, 7
Notropis chrysocephalus (striped shiner)	1	1, 2, 3, 5, 7
Notropis dorsalis (bigmouth shiner)		1, 5, 7
Notropis lutrensis (red shiner)		1
Notropis spilopterus (spotfin shiner)		1, 2, 3, 5, 6, 7
Notropis stramineus (sand shiner)		1, 2, 3, 5, 6, 7
Notropis umbratilis (redfin shiner)	1, 5	1, 2, 3, 5, 6, 7
Phenacobius mirabilis (suckermouth minnow)		1, 5, 6, 7
Pimephales notatus (bluntnose minnow)	1, 5	1, 2, 3, 5, 6, 7
Pimephales promelas (fathead minnow)		7
Semotilus atromaculatus (creek chub)	1, 5	1, 2, 3, 5, 6, 7
Catostomidae (suckers)		
Carpiodes carpio (river carpsucker)		2
Carpiodes cyprinus (quillback)	1	1, 2, 3, 5, 6, 7
Catostomus commersoni (white sucker)	1, 5	1, 2, 3, 5, 7
Erimyzon oblongus (creek chubsucker)	1	1, 2, 3, 5, 7
Minytrema melanops (spotted sucker)		3
Moxostoma duquesnei (black redhorse)		3, 5, 6, 7
Ictaluridae (catfish and bullheads)		
Ictalurus melas (black bullhead)		1, 2, 3, 5, 6
Ictalurus natalis (yellow bullhead)	1	1, 3, 5, 6, 7
Notorus gyrinus (tadpole madtom)	5	6, 7
Cyprinodontidae (killifish)		
Fundulus notatus (blackstripe topminnow)		7

ORGANISM	NURP Sites	SIUC Sites
Centrachidae (sunfishes)		
Lepomis cyanellus (green sunfish)	1, 5	1, 2, 3, 5, 6, 7
Lepomis macrochirus (bluegill)	1	2
Lepomis megalotis (longear sunfish)	1, 5	1, 2, 3, 5, 6, 7
Micropterus salmoides (largemouth bass)	1	1, 2, 3
Percidae (perches and darters)		
Etheostoma nigrum (johnny darter)	1, 5	1, 2, 5
Etheostoma spectabile (orangethroat darter)	5	

*Data from SIUC sites 1, 2, 3, 5, 6, 7 were collected monthly by Jim Waddell and Mike Paller of the Fisheries Department at Southern Illinois University. Data from NURP sites 1 and 5 were collected on September 9, 1982 by the Illinois Department of Conservation in conjunction with IEPA.

Table 4. Relative Abundance (Percent) of fish species collected at Saline Branch Drainage Ditch Sampling Sites between March 1982 and December 1982. Data at SIUC 1-7* were collected by electrofishing techniques and data at NURP Sites 1 and 5 were collected with rotenone techniques.

	SITES						
	*SIUC 1	SIUC 2	SIUC 3	SIUC 5	SIUC 7	NURP 1	NURP 5
Clupeidae (herrings)							
Dorosoma cepedianum (gizzard shad)	0.05	0.50	0.00	0.00	0.00	15.29	0.00
Esocidae (pikes)							
Esox americanus (grass pickerel)	0.00	0.00	0.24	0.12	0.00	0.00	0.00
Cyprinidae (minnows and carps)							
Campostoma anomalum (central stoneroller)	0.32	0.61	6.30	1.20	2.09	0.00	0.18
Cyprinus carpio (common carp)	1.16	0.85	1.60	0.08	1.80	0.57	0.00
Ericymba buccata (silverjaw minnow)	0.92	0.35	1.84	0.48	7.65	0.00	0.00
Nocomis biguttatus (hornyhead chub)	0.00	0.00	0.05	0.05	0.05	0.00	0.00
Notemigonus crysoleucas (golden shiner)	0.00	0.00	0.08	0.00	0.42	0.28	0.00
Notropis chrysocephalus (striped shiner)	0.00	0.00	4.70	1.80	3.90	0.95	0.00
Notropis dorsalis (bigmouth shiner)	0.00	0.00	0.00	1.40	13.00	0.00	0.00
Notropis lutrensis (red shiner)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Notropis spilopterus (spotfin shiner)	0.00	0.00	0.05	0.00	0.05	0.00	0.00
Notropis stramineus (sand shiner)	0.18	0.93	0.40	6.50	3.10	0.00	0.00
Notropis umbratilis (redfin shiner)	7.16	4.25	5.27	1.60	0.18	0.28	0.35
Phenacobius mirabilis (suckermouth minnow)	0.00	0.00	0.00	0.43	1.00	0.00	0.00
Pimephales notatus (bluntnose minnow)	71.38	66.43	24.74	66.08	32.17	14.43	88.93
Pimephales promelas (fathead minnow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Semotilus atromaculatus (creek chub)	1.25	2.90	20.11	8.10	4.70	1.99	0.35
Catostomidae (suckers)							
Carpiodes carpio (river carpsucker)	0.00	0.23	0.00	0.00	0.00	0.00	0.00
Carpiodes cyprinus (quillback)	0.83	0.54	0.48	0.44	0.40	2.09	0.00
Catostomus commersoni (white sucker)	3.84	2.20	21.65	1.60	3.00	14.15	0.18
Erimyzon oblongus (creek chubsucker)	0.00	0.00	0.00	0.00	0.00	0.09	0.00
Minytrema melanops (spotted sucker)	0.00	0.00	0.05	0.00	0.00	0.00	0.00
Moxostoma duquesnei (black redhorse)	0.00	0.00	0.05	0.05	0.05	0.00	0.00
Ictaluridae (catfish and bullheads)							
Ictalurus melas (black bullhead)	0.00	0.00	0.05	0.05	0.00	0.00	0.00
Ictalurus natalis (yellow bullhead)	0.18	0.00	0.15	0.18	0.00	0.75	0.00
Notorus gyrinus (tadpole madtom)	0.00	0.00	0.00	0.00	0.05	0.00	0.00
Cyprinodontidae (killifish)							
Fundulus notatus (blackstripe topminnow)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4. Cont.

Centrarchidae (sunfishes)							
Lepomis cyanellus (green sunfish)	2.36	8.34	10.45	4.76	0.27	11.68	2.81
Lepomis macrochirus (bluegill)	0.00	0.12	0.00	0.00	0.00	0.09	0.00
Lepomis megalotis (longear sunfish)	5.36	9.97	6.86	3.47	1.75	32.29	5.10
Micropterus salmoides (largemouth bass)	0.05	0.05	0.05	0.00	0.00	0.19	0.00
Percidae (perches and darters)							
Etheostoma nigrum (Johnny darter)	0.23	0.00	0.00	0.00	0.00	0.47	1.05
Etheostoma spectabile (orangethroat darter)	0.00	0.00	0.00	0.00	0.00	0.00	0.18

* Data from sites 1, 2, 3, 5, 7 were collected monthly during 1983 by Jim Waddell and Mike Paller of the Fisheries Department at Southern Illinois University. Data from NURP sites 1 and 5 were collected on September 9, 1982 by the Illinois Department of Conservation in conjunction with IEPA.

The relative abundance for SIUC sites 1, 2, 3, 4 and 7 are calculated from the mean of 10 monthly samples. Data from NURP Sites 1 and 5 are based on data collected on September 9, 1982.

Table 5. Fish species with relative abundances (in percent) greater than five percent. Data was collected by Southern Illinois University with electrofishing techniques at SIUC Sites 1-7 and by Illinois Department of Conservation with rotenone techniques at NURP Sites 1 and 5.

Fish Species	Relative Abundance in Percent						
	SIUC 1*	SIUC 2	SIUC 3	SIUC 5	SIUC 7	NURP 1	NURP 5
Dorosoma cepedianum (gizzard shad)	-	-	-	-	-	15	-
Campostoma anomalum (central stoneroller)	-	-	6	-	-	-	-
Ericymba buccata (silverjaw minnow)	-	-	-	-	8	-	-
Notropis dorsalis (bigmouth shiner)	-	-	-	-	13	-	-
Notropis stramineus (sand shiner)	-	-	-	7	-	-	-
Notropis umbratilis (redfin shiner)	7	-	5	-	-	-	-
Pinnephales notatus (bluntnose minnow)	71	66	25	66	32	14	89
Semotilus atromaculatus (creek chub)	-	-	20	8	-	-	-
Catostomus commersoni (white sucker)	-	-	22	-	-	14	-
Lepomis cyanellus (green sunfish)	-	8	10	-	-	12	-
Lepomis megalotis (longear sunfish)	5	10	7	-	-	32	5
Percent of total	83	84	95	81	53	87	94

* Data from Sites 1, 2, 3, 5 and 7 were collected monthly by Jim Waddell and Mike Paller of the Fisheries Department at Southern Illinois University during 1982. Data from NURP Sites 1 and 5 were collected on September 9, 1982 by the Illinois Department of Conservation in conjunction with IEPA.

Table 6. Water Quality Analysis for grab sample collected at NURP Sites 1 and 5 on 9/28/82. All results are reported in mg/l.

Parameter	Sites NURP 1	Sites NURP 5	Water Quality Standard
Total Ammonia - N	.1K*	.1K	-
Total NO2 + NO3 - N	.47	.50	-
Total Kjeldahl nitrogen	2.10	5.80	-
Total phosphorus	.28	6.60	-
Dissolved phosphorus	.02	6.30	-
Calcium	54.00	42.00	-
Magnesium	43.00	22.00	-
Sodium	35.00	91.00	-
Potassium	3.60	10.00	-
Lead	.05K	.05K	.70
Manganese	.50	.05	1.00
Nickel	.02	.01	1.00
Silver	.003K	.003K	.005
Barium	.13	.03	5.00
Boron	.13	.60	5.00
Beryllium	.005K	.005K	-
Cadmium	.003K	.003K	.05
Strontium	.16	.20	-
Vanadium	.01	.005K	-
Zinc	.10K	.05K	1.00
Total Chromium	.01	.01	1.00
Total Copper	.01	.01	.02
Cobalt	.005K	.005K	-
Iron	5.90	.15	1.00
Hardness	312.00	153	

* K indicates that the actual concentration is lower than the detection level which is given.

The proximity of NURP Site 1 and SIUC Sites 1 and 2 made a comparison of electrofishing and rotenone feasible. The samples collected with rotenone tend to contain a larger number of fish and a slightly larger diversity. Several species such as Dorosoma cepedianum (gizzard shad), Catostomus commersoni (white sucker) and Cyprinus Carpio (carp) were more prevalent in the rotenone samples indicating that electrofishing may not be as effective on larger fish or bottom feeders as the rotenone method. This data must be viewed with caution because the comparison was made on only 2 grab samples.

Table 7. A comparison of fish data collected by SIUC on September 1982 and by the Illinois Department of Conservation in conjunction with the Illinois Environmental Protection Agency on September 28, 1982. (See Figure 1 for locations.)

Species	Number of Fish Collected SIUC Sites SIUC 1 (E)	SIUC 2 (E)	IEPA-NURP Site NURP 1 (R)
Clupedea (herrings)			
Dorosoma cepedianum (gizzard shad)	3	13	161
Cyprinidae (minnows and carp)			
Campostoma anomalum (central stoneroller)	1	1	0
Cyprinus Carpio (carp)	0	0	6
Ericymba buccata (silverjaw minnow)	2	0	0
Notemigonus crysoleucas (golden shiner)	0	0	3
Notropis chrysocephalus (striped shiner)	0	0	10
Notropis stramineus (sand shiner)	17	2	0
Notropis umbratilis (redfin shiner)	9	7	3
Pimnephales notatus (bluntnose minnow)	201	67	152
Catostomidae (suckers)			
Carpoides cyprinus (quill back)	0	2	22
Catostomus commersoni (white sucker)	6	21	149
Erimyzon oblongues (creek chubsucker)	0	2	1
Ictaluridae (catfish and bullhead)			
Ictaluras natalis (yellow bullhead)	0	0	8
Centrachidae (sunfish)			
Lepomis cyanellus (green sunfish)	25	76	123
Lepomis macrochirus (bluegill)	0	0	1
Micropterus Salmoides (largemouth bass)	1	1	2
Percidae (perches and clartirs)			
Ethoestoma nigrum (johnny darter)	0	2	5
Total number	265	194	646

(E) Electrofishing Collection
(R) Rotenone Collection

Habitat Assessment

The data collected at NURP Site 1 and NURP Site 5 confirms differences between the two sites. NURP Site 1 averaged 33 feet in width and is a pool with an average velocity of virtually zero. Average depth was 0.67 feet with the depth of the center pool averaging 1.1 feet. The predominant substrate type was sand. However, gravel and rubble predominated at several transects.

NURP Site 5 had an average channel width of 55 feet and is classified as a run. Average depth was .73 feet. This site was more uniform than NURP Site 1 with the stream bed containing fewer topographic variations than the upstream site. The average velocity at this site is .6 feet per second with a velocity of over 1 foot per second in the center portion of the stream. Substrate bottom type was predominately gravel with isolated portions of sand and rubble. Field data is provided in Appendix I.

Macroinvertebrates

Table 8 contains the taxonomic distribution of macroinvertebrates at both SIUC and IEPA sampling stations on Saline Branch Drainage Ditch. Tables 9 and 10 contain the relative abundance of species found at both sites.

A Kruskal Wallis test indicated that there was no significant difference at the 0.5 level in the total number of taxa between stations or upstream and downstream from the sewage treatment plant outflow for the SIUC stations (Heidinger et al. 1983). Analysis of Variance (ANOVA) and a Least Significant Difference Multiple Comparison Procedure were run on the SIUC macroinvertebrate data to determine whether there was a significant difference in the mean number of organisms in the following groups: Oligochaeta, Planariidae, Ephemeroptera and Diptera. As with the fish data SIUC Site 6 was eliminated from the analysis because this site is physically different than all the other sites. There were no significant population differences between sites for Oligochaeta or Planariidae. The Ephemeroptera population was significantly lower at the .05 level than the other sites analyzed, and the Diptera population was significantly higher at SIUC Site 3 than the other sites. Within the Diptera only the Orthocladinae had significantly higher mean totals. SIUC Site 3 is almost directly downstream from the outfall of the Urbana-Champaign NE Sewage Treatment Plant, and the higher nutrient levels would be conducive to this organism.

The qualitative nature of the IEPA data prevented statistical analysis of data. However, the most dramatic difference in the number of taxa occured at those stations located on Boneyard Creek which is a totally urban and modified stream with limited habitat. Total number of organisms collected for Boneyard Creek were 125 at each site as opposed to 298, 303, and 721 at NURP Sites 1, 4 and 5 respectively.

Table 8. Benthic Macroinvertebrates collected in Saline Branch Drainage Ditch by Heidinger et al. and the Illinois Environmental Protection Agency between October 1981 through February 1983, numbers indicate stations at which macroinvertebrates were collected.

ORGANISM	*NURP Sites	SIUC Sites
Coelenterata (Hydras)		
Hydrozoa		
Hydridae		
Hydra sp.		1, 6, 7
Platyhelminthes		
Turbellaria (flat worms)	3, 4, 5	
Tricladia		
Planariidae		
Dugesia sp.		1, 2, 3, 5, 6, 7
Nematoda (round worms)		3
Annelida (worms)		
Oligochaeta (Aquatic Earthworms)	1, 2, 3, 4, 5	
Plesiopora		
Naididae		
Nais sp.		1, 2, 3, 5, 6, 7
Chaetogaster sp.		3, 5, 6, 7
Stylaria sp.		3
Tubificidae		
Limnodrilas sp.		1, 2, 3, 5, 6, 7
Prosopora		
Lumbriculidae		3, 5, 6, 7
Hirudinea (Leeches)	4, 5	
Rhynchobdellida		
Glossiphoniidae		
Placobdella sp.		2
Pharynoqobdellia		
Erpobdellidae		
Eropobdella sp.		3, 5, 7

Table 8. Cont'd

ORGANISM	NURP Sites	SIUC Sites
Anthropoda		
Crustacea		
Copepoda		3, 6
Isopoda (sow bugs)		
Asellidae (sow bug)		
Asellus sp.		1, 2, 3, 5, 6, 7
Lirceus sp.	1, 5	1, 2, 3, 5, 6, 7
Gammaridae		
Bactrurus sp.		2
Synurella sp.		6
Decapoda (crayfish)		
Palaemonidae		
Palaemonias sp.		
Cambarinae		1, 2, 5, 6, 7
Astacidae	4, 5	
Orconectes sp.		1, 2
Amphipoda (amphipods)		
Hyalellida		
Hyalella azteca	4	
Insecta -		
Plecoptera (stoneflies)		
Taeniopterygidae		
Taeniopteryx sp.	1	1, 2, 3, 5, 7
Perlodidae		
Isoperla sp.		1, 3
Ephemeroptera (mayflies)		
Ephemeridae		
Hexagenia sp.	1	1, 2, 6
Potamanthidae		
Potamanthus sp.		2, 6
Siphlonuridae		
Isonychia sp.	1, 4	1, 2, 3, 5, 7
Caenidae		
Caenis sp.	1, 4, 5	1, 2, 3, 5, 6, 7
Tricorythidae		
Tricorythodes sp.	1, 4	
Baetidae		
Baetis sp.	1, 5	1, 2, 3, 5, 6, 7
Heterocloeon sp.	1	
Heptageniidae		
Heptaenia sp.	1, 4, 5	1, 2, 3, 5, 6, 7
Stenacron interpunctatum	1, 4, 5	
Stenonema sp.	1, 4	1, 2, 3, 5, 6, 7

Table 8. Cont'd

ORGANISM	NURP Sites	SIUC Sites
Odonata (dragon flies, damsel flies)		
Gomphidae		
Gomphus sp.		1
Corduliidae		
Somatochlora sp.		1
Calopterygidae		
Calopteryx sp.	4	
Hetaerina sp.		7
Coenagrionidae		
Argia sp.	4, 5	1, 2, 3, 5, 6, 7
Ischnura sp.	1, 2, 3, 4, 5	1, 2, 3, 5, 6, 7
Hemiptera (true bugs)		
Corixidae		2
Sigara sp.	4, 5	
Gerridae		
Gerris sp.	4	
Veliidae		
Microvelia sp.	4	
Hydropsychidae		
Cheumatopsyche sp.	1, 4, 5	1, 2, 3, 5, 6, 7
Hydropsyche sp.	1	2
Hydroptilidae		
Agraylea sp.		6
Hydroptila sp.		1, 3
Coleoptera (beetles)		
Hydrophilidae		
Berosus sp.		1
Pryopidae		
Helichus sp.		2
Elmidae		
Aneyronyx Variegatus		2
Dubiraphia sp.	1, 4	1, 2, 3, 5, 6, 7
Stenelmis sp.	5	1, 2, 6, 7
Dytiscidae		
Locophilus sp.	4	
Gyrinidae		
Dineutus sp.	1, 4	

Table 8. Cont'd

ORGANISM	NURP Sites	SIUC Sites
Diptera (flies, midges)		
Tipulidae (crane flies)		
Tipula sp.		1, 2, 3, 6
Simuliidae (black flies)		
Simulium sp.	1, 5	1, 2, 3, 5, 6, 7
Chironomidae (midges)	1, 2, 3, 4, 5	
Orthocladinae		1, 2, 3, 5, 6, 7
Chironomus sp.		1, 2, 3, 5, 6, 7
Cryptochironomus sp.		1, 2, 3, 6, 7
Pentaneura sp.		1, 2, 3, 5, 6, 7
Procladius sp.		1, 2, 3, 5, 6, 7
Tanytarsus sp.		1, 2, 3, 5, 6, 7
Ceratopogonidae (biting midges)		
Palpomyia sp.	1	1
Rhagionidae (snipe flies)		1, 2, 3, 5, 6, 7
Anthomyiidae		
Limnophora sp.		2
Mollusca		
Gastropoda (snails, limpets)		
Basommatophora		
Physa sp.	1, 2, 3, 4, 5	1, 2, 3, 5, 6, 7
Lymnaeidae		
Lymnaea sp.	2, 4	1, 3, 5
Planorbidae		
Planorbula sp.	2, 5	
Gyraulus sp.		1, 6, 7
Itellisoma sp.		6
Ancylidae		
Ferrisia sp.		1, 3, 5, 6, 7
Pelecypoda (clams, mussels)		
Heterodonta		
Cyrenidae		
Corbicula fluminea		1, 3, 7

Data from SIUC Sites were collected monthly between March 1982 - February 1983 by Jim Waddell and Mike Paller of the Fisheries Department at Southern Illinois University at Carbondale

Data from NURP Sites was collected by IEPA on October 28-29, 1981

Table 9. Relative Abundance of Macroinvertebrates (percent) at Southern Illinois University Saline Branch Drainage Ditch Sites between March 1982 and February 1983 using Hester Dendy artificial substrate samplers.

Species	SIUC 1	SIUC 2	SIUC 3	SIUC 5	SIUC 6	SIUC 7
Coelenterata (hydras)	<1	-	-	-	<1	<1
Platyhelminthes (flat worms)						
Planariidae	3	2	<1	6	20	6
Nematoda (round worms)	-	-	<1	-	-	-
Annelida worms (aquatic earth worms)						
Oligochaeta						
Naididae	<1	<1	21	51	7	31
Tubificidae	2	1	2	4	4	2
Lumbriculidae	-	-	<1	<1	<1	<1
Hirudinea (leeches)	-	<1	<1	<1	-	<1
Anthropoda (anthropods)						
Crustacea	<1	<1	<1	<1	<1	2
Insecta - (insect)						
Plecoptera (stoneflies)	<1	<1	<1	<1	<1	<1
Ephemeroptera (mayflies)						
Caenidae	27	10	<1	<1	2	2
Baetidae	2	<1	<1	<1	<1	<1
Heptageniidae	25	10	6	4	13	13
Other	<1	<1	<1	<1	<1	<1
Odonata (dragon flies, damsel flies)	<1	2	<1	<1	1	3
Hemiptera (true bugs)	7	1	2	<1	<1	<1
Coleoptera (beetles)	<1	2	<1	<1	<1	<1
Diptera (flies, midges)						
Simuliidae (black flys)	<1	1	3	11	4	3
Chironomidae (midges)						
Orthocladinae (midges)	12	16	46	15	25	17
Chironomus sp.	9	7	14	3	14	9
Cryptochironomus sp.	<1	<1	<1	-	<1	<1
Pentaneura sp.	5	4	3	3	5	5
Procladius sp.	<1	<1	<1	<1	<1	<1
Tanytarsus sp.	2	1	<1	<1	<1	<1
Ceratopogonidae (biting midge)	<1	-	-	-	-	-
Rhagionidae (snipe flys)	<1	<1	<1	<1	<1	<1
Mollusca (mollusks)						
Gastropoda (snails, limpets)	<1	<1	<1	<1	<1	<1
Plecypoda (clams, mussells)	<1	-	<1	-	-	<1

Table 10. Relative Abundance of Macroinvertebrates (percent) at the NURP Sites October 28-29, 1981.

Species	NURP 1	NURP 2	NURP 3	NURP 4	NURP 5
Platyhelminthes					
Turbellaria	-	-	.80	.33	7.20
Annelida	.67	1.60	.80	1.90	41.00
Oligochaeta					
Hirudinea	-	-	-	.66	.14
Anthropoda					
Decapoda					
Astacidae	-	-	-	.14	.66
Isopoda					
Asellidae					
Lirceus sp.	.14	-	-	-	.13
Amphipoda					
Hyalellidae					
Hyalella azteca	-	-	-	.66	.13
Insecta - (insect)					
Plecoptera (stoneflies)					
Taeniopterygidae					
Taeniopteryxnivalis sp.	5.30	-	-	-	-
Ephemeroptera (mayflies)					
Ephemeridae					
Hexagenia limbuta	.14	-	-	-	-
Siphlonuridae					
Isonychia sp.	.66	-	-	.14	-
Caenidae					
Caenis sp.	18.00	-	-	14.00	3.00
Tricorythidae					
Tricorythodes sp.	1.00	-	-	4.00	-
Baetidae					
Baetis sp.	23.00	-	-	-	-
Heterocloenon sp.	.14	-	-	-	-
Heptageniidae					
Heptaenia diabasia	8.00	-	-	3.00	-
Stenacron interpunctatum	8.00			36.00	36.00
Stenonema pulchellum	-	-	-	.66	
Stenonema terminatum	-	-	-	.99	-
Stenonema sp.	.66	-	-	-	-
Odonata (dragon flies, damsel flies)					
Calopterygidae					
Calopteryx sp.	-	-	-	.66	-
Coenagrionidae					
Argia sp.	-	-	-	-	.13
Ischnura sp.	2.30	3.20	1.60	.130	.41

Table 10. Cont'd

Species	NURP 1	NURP 2	NURP 3	NURP 4	NURP 5
Hemiptera (true bugs)					
Corixidae					
Sigara sp.	-	-	-	.33	.13
Gerridae	-	-	-	.33	-
Gerris sp.	-	-	-	.33	-
Veliidae					
Microvelia sp.	-	-	-	.33	-
Trichoptera					
Cheumatopsyche sp.	10.4	-	-	8	.83
Hydropsyche bifida	.14				
Hydropsyche simulans	1	-	-	-	-
Coleoptera (beetles)					
Elmidae					
Dubiraphia sp.	2.3	-	-	.33	
Stenelmis sp.	-	-	-	-	.13
Dytiscidae					
Locophilus sp.	-	-	-	.33	-
Gyrinidae	1.67				
Dineutus sp.	2.3	-	-	-	-
Diptera (flies, midges)					
Simuliidae (black flies)					
Simulium sp.	3.36	-	-	-	2.6
Chironomidae (midges)	11.07	34.4	33.6	6.6	6.5
Ceratopogonidae (biting midges)					
Palpomyia sp.	.14	-	-	-	-
Mollusca					
Gastropoda (snails, limpets)					
Physidae					
Physa sp.	1	59.2	63.2	16.8	.139
Lymnaeidae	.8	-	-	.33	-
Lymnaea sp.					
Planorbidae	-	.8	-	-	-
Planorbula sp.					

Table 11. Water quality data for NURP Sites on the Saline Branch Drainage Ditch and Boneyard Creek, Champaign, Illinois October 28-29, 1981. All results are reported in mg/l.

Parameter	NURP 1	NURP 2	NURP 3	NURP 4	NURP 5	Water Quality Standard
Water Temp. °C	11.00	14.00	13.00	12.00	14.00	-
Field D.O.	13.20	8.20	8.00	13.10	8.00	-
Field pH	7.60	7.60	7.50	7.70	7.40	-
Field Cond. us/CM	750.00	770.00	850.00	750.00	820.00	-
TSS	7.00	1.00	0.00	4.00	6.00	-
TDS	437.00	577.00	579.00	450.00	540.00	1000.00
Sulfate	42.00	90.00	92.00	55.00	64.00	-
Chloride	24.00	39.00	38.00	28.00	35.00	-
NH3-N	<0.10	0.46	0.76	<0.10	2.20	1.50
NO2+NO3-N	14.00	1.80	1.70	10.00	8.30	-
Total Kjeldahl N	0.10	1.30	1.40	0.40	4.00	-
Total Phosphorus	0.04	0.30	0.37	0.08	3.30	-
COD	16.00	13.00	9.00	6.00	19.00	-
BOD	1.00	2.00	2.00	2.00	9.00	-
Lead	<0.05	<0.05	<0.05	<0.05	<0.05	0.10
Copper	<0.005	<0.005	<0.005	<0.005	<0.005	0.20
Iron	0.18	0.18	0.33	0.17	0.14	1.00
Zinc	<0.005	0.007	0.009	<0.005	0.015	1.00
Chromium	<0.005	<0.005	0.023	<0.005	<0.005	1.00
Cadmium	<0.003	<0.003	0.003	<0.003	<0.003	0.05
Manganese	<0.011	0.036	0.068	0.03	0.036	1.00
Nickel	<0.005	<0.005	<0.005	<0.005	<0.005	1.00
Mercury	---	<0.05	<0.05	---	---	0.50
Discharge CFS	43.1	2.10	1.60	64.2	101.5	-

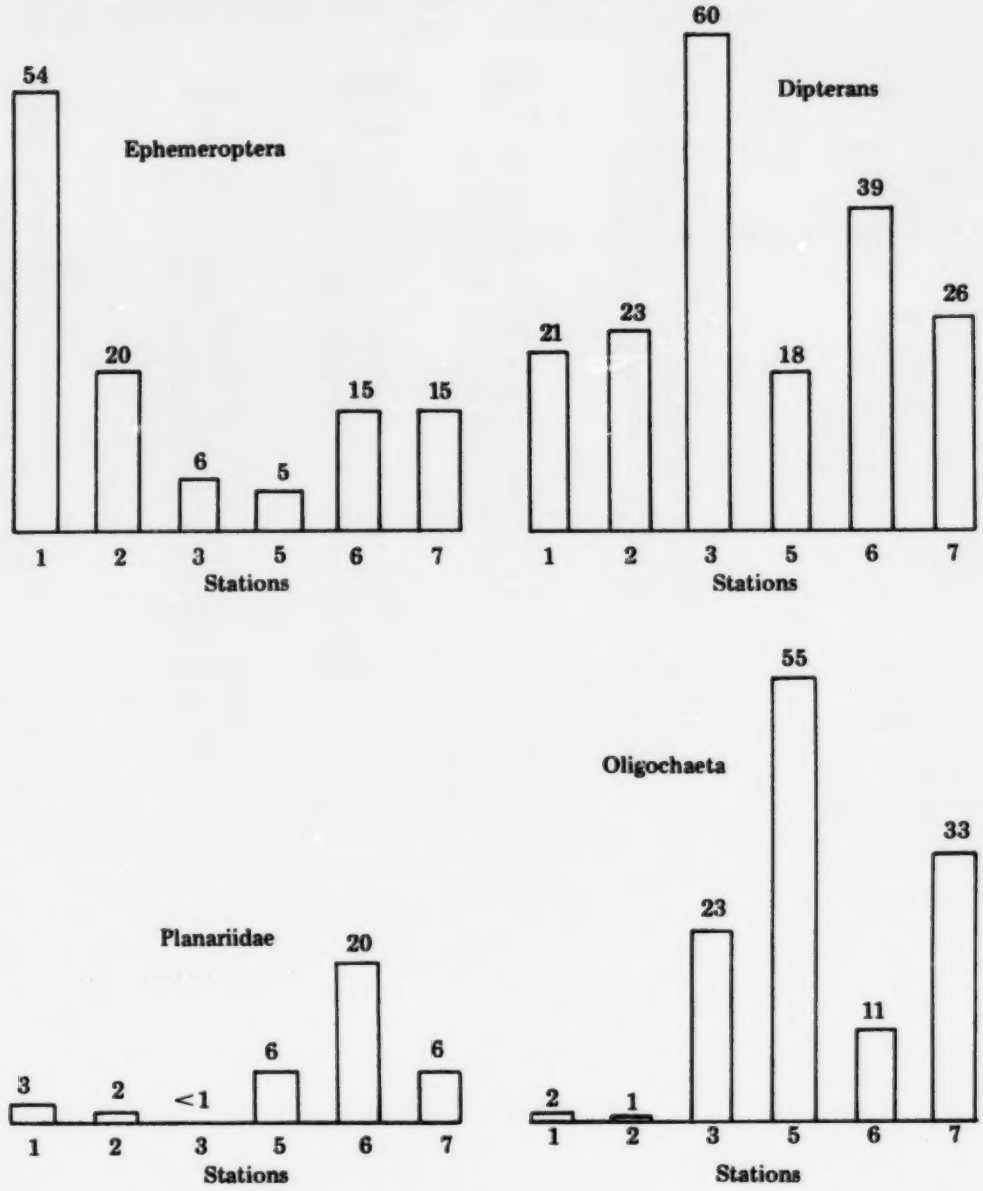

Figure 2. Percent Composition of Ephemeroptera, Dipteran, Planariidae, and Oligochaeta at the SIUC Sites on the Saline Drainage Ditch. Sites progress from upstream at SIUC Site 1 to downstream at SIUC Site 7. The Champaign-Urbana STP is located between SIUC Sites 2 and 3.

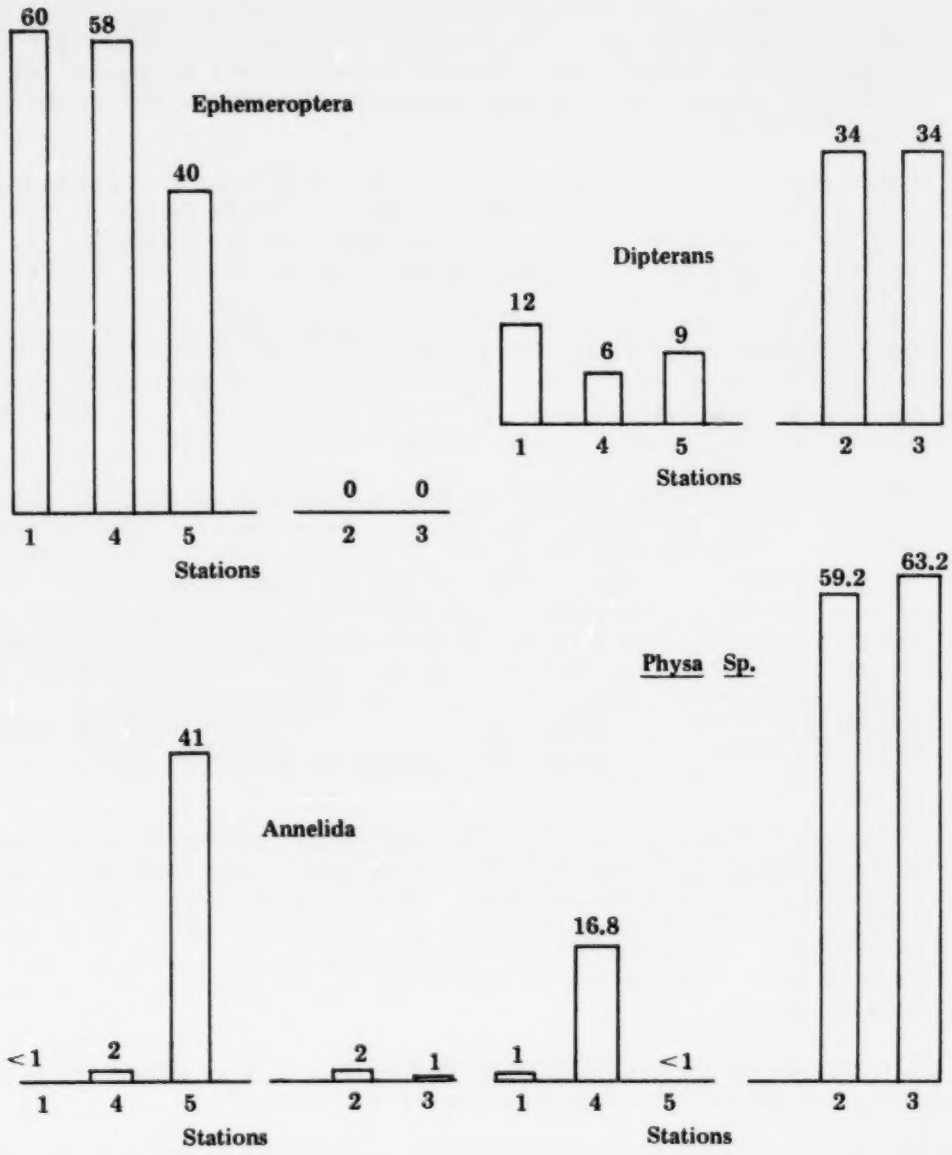

Figure 3. Percent Composition of Ephemeroptera, Dipterans, Annelida and Physa sp. at NURP Sites 1, 4 and 5 on the Saline Drainage Ditch, and 2 and 3 on the Boneyard Creek. Site 1 is located above both the urban area and the Champaign STP. Site 4 is located below the urban area but above the STP and Site 5 is located below the Champaign STP. Site 2 and 3 are on the Boneyard.

Species composition at the various sites are significantly different. Figures 2 and 3 indicate the differences in species composition at both the SIUC and NURP sites. The figures illustrate the percentage of Ephemeroptora, Planariidae, Oligocheta and Diptera at each sites. The difference between major groups upstream, downstream and in the urban areas is dramatic.

Ephemeroptera predominate at SIUC Sites 1 and 2 while Planariidae and Oligocheta are virtually absent. A dramatic shift occurs at SIUC Site 3 and 5 with the percent of all Ephemeroptera except Stenacron sp. falling below 3%. Nais sp. and Orthocladinae, both of which are pollution tolerant, dominate at SIUC Sites 3 and 5. Nais sp. constitutes 21% of the population at Site 3 and 51% of the population at Site 5 while Orthocladinae constitutes 46% of the population at SIUC Site 3 and 15% of the population at SIUC Site 5. The Ephemeroptera population begins to recover at SIUC Sites 6 and 7 which are 10.1 and 12.6 Km downstream of the Urbana-Champaign Northeast Sewage Treatment Plant.

The macroinvertebrate population trends observed in the SIUC data are similar in the NURP data. The Ephemeroptera (mayfly) species found at NURP Site 1 are only slightly different than those found at Site 4 which is downstream from Urbana-Champaign but upstream from the STP. There were 9 species of Ephemeroptera at NURP Site 1 and 7 species of Ephemeroptera at Site 4. The increase in Stenaacron interpunctatum may in part be due to increased flow at this site. At Site 5 which is downstream of the sewage treatment plant only two species of Ephemeroptera remain, Caenis sp. which consists of 3% of the total organisms present and Stenacron interpunctatum which consists of 36% of the population present.

Trichoptera (caddis fly) which is a pollutant sensitive group shows trends similar to Ephemeroptera. Three species are present at NURP Site 1 upstream from Urbana-Champaign. This is reduced to 1 species at Sites 4 and 5. However, Cheumatopsyche sp. consists of 8% of the population at Site 4 and only .8% at Site 5. Coleoptera (beetle) also has been reduced from 6% of the population at Site 1 to .7% at Site 4 and finally to <.2% at Site 5.

Oligochaeta which was .67% at NURP Site 1 and 2% at NURP Site 4 has increased to 41% of the population at NURP Site 5.

Species diversity drops dramatically in Boneyard Creek with the number of species being 6 and 5 at NURP Sites 2 and 3 respectively as opposed to 22, 23 and 17 at NURP Stations 1, 4 and 5 which are located in the Saline Branch Drainage Ditch. Chironomidae and Physa sp. dominated at Boneyard Creek Sites averaging 34% and 60% at both sites. Site 4 showed an urban influence with 17% of the macroinvertebrate community belonging to Physa sp. as opposed to 1% and .1% at NURP Site 1 and NURP Site 5.

Bank vegetation

Table 12 contains the plant species found at NURP Sites 1, 3, 4 and 5. This species list is not all inclusive. Plants composition and coverage were estimated visually as time constraints prevented more in depth analysis. The species lists give a general picutre of the types of species and bank coverage at each site sampled. Percent coverage of predominant species are given at all sites except NURP Site 4 which was dominated by trees with virtually no forb understory species. Lack of percentages indicates that percent coverage was 1 percent or less. In some cases where vines covered shrubs and forbs percent coverage may be greater than 100%.

NURP Site 1 was predominately grasses with vegetative coverage approaching 100% except for one strech on the left bank which had severe erosion problems. Setaria viridis (green foxtail) was the major pioneer species in these areas.

NURP Site 3 was on Boneyard Creek and had steep banks with variable cover. Shrubs which extended in a band approximately 20 ft. (6m) were predominate on both banks.

NURP Site 4 was at an old U.S.G.S. gauging site. This site was also quite steep and was dominated by Quercus velutina (black oak) and Fraxinus americana (white ash). A heavy leaf litter prevented the growth of forbs. Trees on the right bank, where the sewage treatment plant was located appeared chlorotic.

NURP Site 5 was predominately grasses and forbs upstream of the site. Diversity was less than at Site 1 but plant coverage was denser. Trees predominated downstream from the site.

Table 12. Species composition and coverage at NURP Sites 1, 3, 4 and 5 Fall 1982.

NURP 1

Chenopodiaceae
Chenopodium album (lamb's quarter)

Polygonaceae
Polygonum aviculare (prostate knotweed)
Polygonum hydropiperoides (mild water pepper)
Polygonum lapathifolium (pale smartweed)
Polygonum pensylvanicum (common smartweed) *[R.B 1-2%; L.B <1%]

Hippocastanaceae
Acer Saccharium (silver maple)

Vitaceae
Vitis sp. (grape) [R.B 5%; L.B <1%]

Rosaceae
Rubus sp. (black berry)

Leguminosae
Trifolium repens (white clover)

Salicaceae
Salix sp. (willow)

Moraceae
Humulus japonicus (hops)

Urticaceae
Pilea pumila (clear weed) [R.B 10% L.B <1%]
Urtica dioica (stinging nettle)

Onagraceae
Ludwigia alternifolia (seedbox)

Oleaceae
Fraxinus americana (white ash)

Polemoniaceae
Phlox sp. (sweet william)

Solanaceae
Solanum nigrum (deadly nightshade) [R.B 1-2%; L.B <1%]

Compositae
Bidens bipinnata (spanish needles)
Ambrosia trifida (giant ragweed) [R.B - 40-45%; L.B. 10%]
Aster pilosus (hairy aster)
Eupatorium altissium (tall thoroughwort)
Eupatorium rugosum (white snakeroot)
Solidago nemoralis (field goldenrod) [R.B 1-2%; L.B <1%]
Xanthium strumarium (common cocklebur)

Smilacacae
Smilax glauca (greenbriar)

Cyperaceae
Cyperus sp. (sedge)

Graminae
Agropyron repens (quack grass)
Bromus tectorum (downy chess)
Digitaria Sanguinalis (crabgrass)
Echinochloa sp. (barnyard grass) [R.B 20%; L.B 1%]
Elymus virginicus (wild rye) [R.B <1%; L.B 1%]
Eragrostis spectabilis (love grass) [R.B. <1%; L.B. 75-80%]
Panicum virgatum (switchgrass) [R.B. 20%; L.B 20%]
Setaria viridis (green foxtail)
Sorghastrum nutans (indian grass) [R.B <1%; L.B 1%]

NURP 3

Violaceae
Viola sp. (violets)

Polygonaceae
Polygonum hydropiperoides (water pepper)
Polygonum lapathifolium (pale smartweed)
Polygonum pensylvanicum (smartweed)

Anacardiaceae
Rhus glabra (smooth sumac) [R.B - 25%; LB. - 5%]

Vitaceae
Vitis sp. (grape) [R.B 5-10; L.B 50%]

Leguminusae
Trifolium sp. (clover) [RB - 1-2%; LB - 5%]

Convoluvulaceae
Convolvulus sp. (bindweed)

Solanaceae
Solanum nigrum (deadly nightshade)

Labiatae
Glechoma hederaceae (ground ivy) [R.B 5%; LB 1-2%]

Caprifoliaceae
Sambucus canadensis (common elderberry) [R.B 5%; L.B 90%]

Graminae
Digitaria sp. (crab grass)
Panicum virgatum (switchgrass)
Setaria viridis (green foxtail)

NURP 4

Tiliaceae
Tilia americana (basswood)

Simarubaceae
Ailanthus altissima (tree of heaven)

Rosaceae
Crataegus sp. (hawthorn)

Fagaceae
Quercus velutina (black oak)

Oleaceae
Fraxinus americana (white ash)
Forsythia sp. (forsythia)

Caprifoliaceae
Lonicera tatarica (tatarian honeysuckle)
Sambucus canadensis (common elderberry)

NURP 5

Polygonaceae
Polygonum aviculare (prostate knotweed)
Polygonum hydropiperoides (water pepper)
Polygonum lapathifolium (pale smartweed)
Polygonum pensylvanicum (smartweed)

Balsaminaceae
Impatiens biflora (jewelweed)

Rosaceae
Rubus sp. - [R.B <1% L.B 1-3%]

Leguminosae
Medicago sp. (alfalfa)
Trifolium repens (white clover) [R.B. - 1% LB. 2-5%]

Urticaceae
Boehmeria cyindrica (false nettle)
Urtica dioica (stinging nettle)

Onagraceae
Ludwigia alternifolia (seed box)

Polemoniaceae
Phlox spies (sweet william)

Convolvulaceae
Ipomoea hederacea (ivy-leaf morning-glory)

Compositae
Ambrosia artemisifolia (common ragweed)
Ambrosia trifida (giant ragweed)
Aster pilosus (hair aster)
Aster sp. (aster)
Cirsium vulgare (common thistle)
Rudbeckia hirta (black-eyed susan)
Solidago nemoralis (field goldenrod)
Xanthium strumarium (cocklebur)

Graminae
Elymus virginicus (wild rye) [R.B 40-50% LB 40-50%]
Setaria viridis (green foxtail) [R.B <1%, L.B 5%]
Sorghastrum nutans (indian grass) [RB 40-50% LB 40-50%]

Diel Oxygen

Raw data for dissolved oxygen (D.O.), conductivity, pH, air temperature and water temperature are contained in Appendix II. Figure 4 contains diel oxygen curves for NURP Sites 1, 3, 4 and 5. Table 13 contains the Chlorophyll data and Table 14 the water quality data collected on the day the diel was conducted.

The swing in the D.O. curve was greatest at NURP Site 1 ranging from 3.7 mg/l at 0610 hours to 22 mg/l at 1600 hours. The water at this site had a green tinge indicating an algal bloom. This is supported by chlorophyll and water quality data. The Chlorophyll a reading, which can be used to estimate the biomass of planktonic algae, were 20.3 ug/l (Table 13). Dissolved nutrients were extremely low which indicates that nutrients were being taken up by algae. A total phosphorus level of .1 mg/l compounded by a virtually zero flow are sufficient factors to produce a bloom. Blue green algae are most likely predominant with the presence of chlorophyll b and c indicating either green algae or euglenoids and diatoms or dioflagellates are also present (Kirschner et al. 1983).

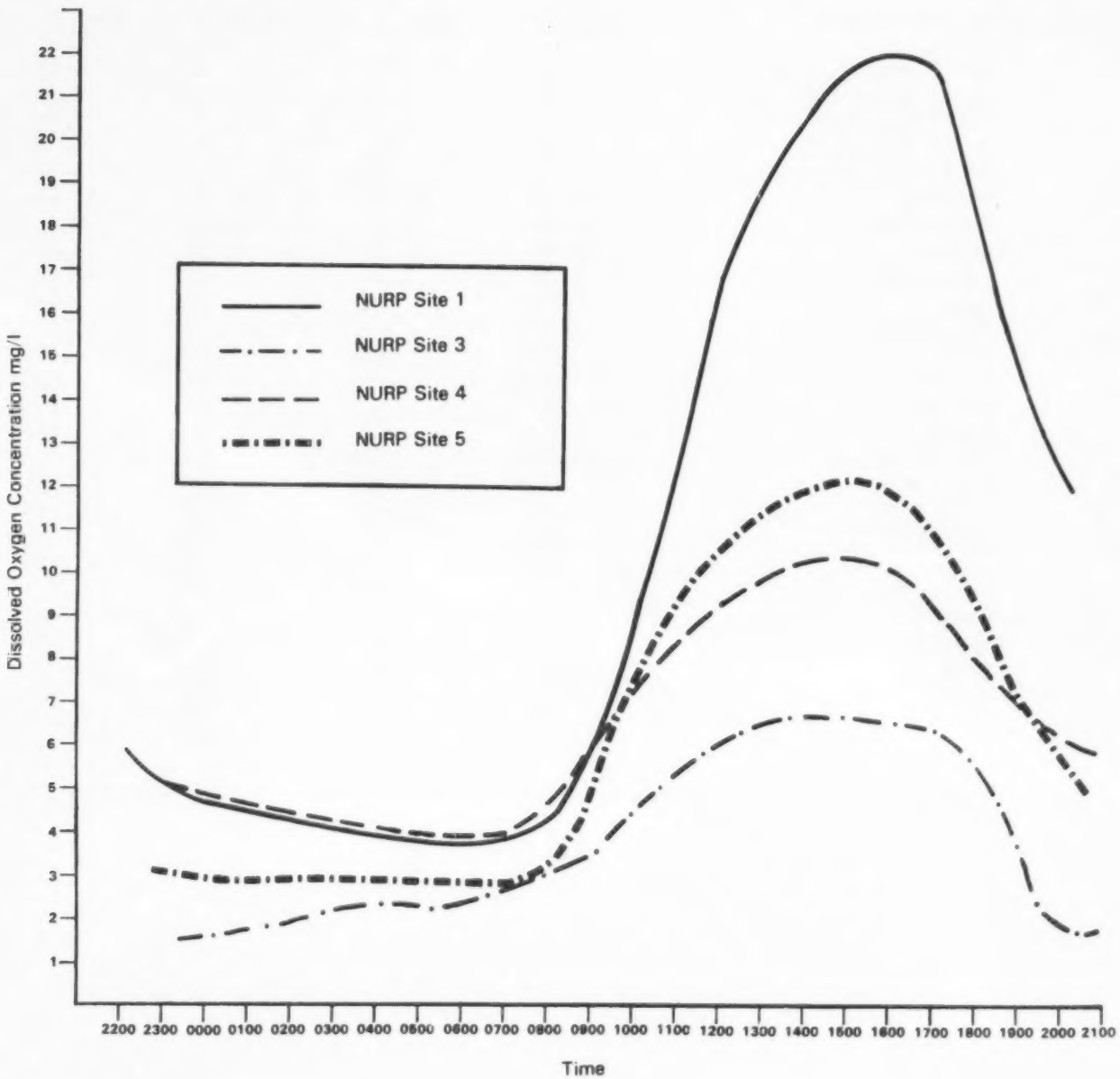

Figure 4. Diel oxygen curves developed from samples at NURP Sites 1, 3, 4 and 5 on 9/8-9/9/82.

Table 13. Water Quality Analysis for grab sample collected on 9/8/82. All results are reported in mg/l at NURP Sites.

Parameter	NURP 1*	NURP 3	NURP 4	NURP 5
Total Ammonia - N	.1K	1.50	.58	4.50
Total NO2 + NO3 - N	.1K	1.50	.69	4.50
Total Kjeldahl - N	1.1	2.30	1.40	5.30
Total phosphorus	.10	.55	.31	4.70
Dissolved phosphorous	.01	.43	.17	4.30
Calcium	55.00	69.00	87.00	50.00
Magnesium	40.00	29.00	36.00	23.00
Sodium	30.00	52.00	43.00	84.00
Potassium	2.30	3.80	3.90	10.00
Lead	.05	.050	.050	.050
Manganese	.114	.071	.181	.089
Nickel	.005	.009	.005	.005
Silver	.003K	.003	.003	.003
Barium	.042	.066	.073	.036
Boron	.116	.450	.322	.529
Beryllium	.0005	.0005	.005	.005
Cadmium	.003	.003	.003	.003
Strontium	.147	.232	.284	.204
Vanadium	.005	.005	.005	.005
Zinc	.150	.150	.158	.100
Chromium	.005	.059	.028	.013
Copper	.006	.007	.005	.005
Cobolt	.005	.005	.005	.005
Iron	.850	.327	.618	.288
Total Mercury	.05K	.05K	.05K	.05K
Dissolved Mercury	.05K	.20	.05K	.05K
Hardness	301.00	292.00	365.00	222.00

* K indicates that the actual concentration is lower than the detection level which is given.

Table 14. Chlorophyll and Pheophytin Content of Algal Samples recorded in ug/l for NURP Sites collected on 9/8-9/9/82.

Sites	Chlorophyll a (Corrected)	Chlorophyll a (Uncorrected)	Chlorophyll b	Chlorophyll c	Pheophytin a
NURP 1	20.30	21.16	2.38	2.71	1.28
NURP 3	1.92	1.06	0.33	0.85	0.0
NURP 4	29.30	29.45	2.02	5.86	0.0
NURP 5	16.07	16.60	2.68	1.37	0.90

NURP Site 3, on Boneyard Creek had a lower D.O. level and smaller range of D.O. values. D.O. ranged from 1.5 mg/l at 2325 hours to 6.6 mg/l at 1444 hours. Several factors may account for this. The algal biomass based on Chlorophyll a readings is 1.92 ug/l compared to values in the high teens and twenties for the other sites. It appears that algal growth has been inhibited. Water quality grab samples taken on 9/8/82 indicate a chromium value of 0.059 mg/l and a dissolved mercury level of 0.2 mg/l which are both subtantially higher than the ambient levels at other NURP sites (Table 13). A summary of dry weather flow quality data taken during the study period also indicates a slightly higher total chromium level than the other NURP sites (see Table 15).

NURP Site 4 had a D.O. range of 3.8 mg/l at 0456 hours to 10.3 mg/l at 1433 hours. The Chlorophyll a content was 29.3 ug/l which is the highest reading at any site. This may be deceptive, because NURP Site 4 is the shadiest site and algae tend to produce more chlorophyll a in sites with less light. The greater flow at this site may in part be responsible for a smaller D.O. peak than at NURP Site 1. The factor inhibiting the algal growth in Boneyard Creek does not have a similar effect at this site. It should be noted that the higher concentration of heavy metals at NURP Site 3 have been diluted at NURP Site 4.

NURP Site 5 had a D.O range of 2.7 mg/l at 0630 hours to 11.8 mg/l at 1418 hours. The nutrient load is highest at this site as would be expected because the site is downstream from the sewage treatment plant. Dissolved Ammonia - N is 4.5 mg/l, dissolved NO2+NO3 - N is 4.5 mg/l, Total kjeldahl - N is 5.3 mg/l, total phosphorus is 4.7 mg/l and dissolved phosphorus 4.3 mg/l. It should be noted that in dry weather flow the discharge from the plant is on the average 19.5 CFS versus the stream's natural flow of 10 CFS. The lower D.O levels at night may in part be the result of higher organic levels resulting from the sewage treatment plant discharge and subsequent breakdowns of this material by bacteria. Algal biomass is less than either NURP Site 1 or 4 with the Chlorophyll a level being 16.07. One reason for the small algae community may be the rapid flow at this site, compared to NURP Site 1 with virtually no flow, which would prevent the build up of an algal population.

Table 15. Summary of Means - Dry Weather Flow Sampling for NURP Sites and IEPA Ambient Monitoring on the Saline Branch Drainage Ditch. All values are in mg/l.

	Ave. CFS	TSS	TDS	SO4	CL	NH3-N	NO3-N	TKN	P	COD	Pb	Cu	Fe	Cr	Mn
*NURP 1	12.50	65	389	37	28	.07**	8.3	.75	.09	17	.035**	.01	1.24	.007**	.08
NURP 2	5.00	5	489	70	47	.58	2.2	1.20	.29	12	.035**	.01*	.20	.007**	.06
NURP 3	7.50	8	540	89	45	.63	1.6	1.30	.34	12	.035**	.03*	.42	.06*	.08
NURP 4	10.00	24	491	63	37	.32*	6.9	.80	.16	11	.035**	.007**	.58	.02*	.07
✓BPJC-04	10.00	-	387	58	32	.32	7.5	-	.64	-	.019	.072	1.10	.002	.07
USCD	19.50	15	-	-	-	8.50	-	-	8.3	-	-	-	-	-	-
✓BPJC-01	-	-	451	75	40	2.07	6.6	-	2.13	-	.009	.072	.90	.010	.09
NURP 5	42.50	22	465	68	41	2.90	7.5	4.20	3.40	21	.035**	.03*	.45	.01*	.05
+ Illinois Water Quality Standards		None	1000	500	500	1.5	None	None	.05	None	.1	.02	1.0	.05	1.0

NURP Sites 2 and 3 are on Boneyard Creek
NURP Sites 4 and BPJC-04 are same site
UCSD is the Urbana Champaign Sanitary District Sewage Treatment Plant outfall

** All results below detection limit
* Some results below detection limit
+ General use water quality standards
+ NURP Sites 1, 3 and 5 were sampled 13 times. Metals were analyzed for 8 of the 13 samples.
NURP Site 2 was sampled 8 times. Metals were analyzed for 5 of the 8 samples.
NURP Site 4 was sampled 11 times. Metals were analyzed for 8 of the 11 samples.
✓ Values are means of results for all samples collected at stations between 1972 to 1981. TDS, NH_3-N, NO3-N and phosphorous were analyzed 53 times at BPJC-01 and 49 times at BPJC-04. Metals, sulfate and chloride were analyzed 11 times at BPJC-01 and 12 times at BPJC-04.

Table 16. Summary of Medians of Log - Normal Distributions of Storm Event Mean Concentrations. All values are in mg/l.

	Mean Peak Storm Flow CFS	TSS	TDS	SO4	CL	NH3-N	NO3-N	TKN	P	COD	PB	CU	FE	CR	MN
*NURP 1	-	164	312	36.6	26.0	0.098	5.13	1.96	0.158	40	0.071	0.011	2.44	.009	.22
NURP 2	-	382	196	29.0	16.3	0.232	0.910	3.65	0.647	184	0.377	0.071	5.64	.018	.50
NURP 3	180	353	195	29.7	14.4	0.232	0.973	3.51	0.607	161	0.349	0.084	6.46	.030	.50
NURP 4	300	372	218	31.0	14.3	0.161	1.84	3.39	0.586	125	0.194	0.046	5.87	.032	.40
NURP 5	230	457	307	43.9	26.0	0.991	4.08	4.30	1.42	93	0.112	0.026	7.00	.023	.43
Illinois Water Quality Standards		None	1000	500	500	1.5	none	none	.05	none	0.1	0.02	1.0	.05	1.0
														1.00	

* Data were collected for 59 rainfall events having a minimum of average intensity of .04 inch per hour. A total of 1075 samples from 31 of the 51 monitored events were analyzed for constituent concentrations.

Discussion

The purpose of this study was to determine whether urban run off from Champaign-Urbana has an impact on the biological composition of Boneyard Creek and the Saline Branch Drainage Ditch. No sampling was conducted during storm events or on the toxicity of urban parameters on fish, macroinvertebrate and plant species. Instead an ecological survey was made during dry weather and differences in species types, species diversity and total numbers were assessed to determine whether there were differences between these parameters upstream from within the urban area and downstream of the urban area. If differences in the organism population were present, an attempt was made to determine whether these differences were attributable to urban runoff, point sources, the sewage treatment plant or habitat.

A concurrent study Bender et al. (1983) demonstrated that urban runoff does elevate certain parameters such as lead, copper and iron to levels 5-10 times the ambient concentrations and well above the Illinois Water Quality Standards. Total suspended solids, phosphorus, Kjeldahl nitrogen, and COD had median event mean concentrations 4-16 times background levels during storm events. However this elevation usually lasted only 2-3 hours beyond the end of a storm event and a substantial portion of kjeldahl nitrogen, copper, lead and iron are associated with suspended solids and therefore not available to the biota. Approximately 91 percent of the NH3-N loaded into the Saline during the study period was attributable to the treatment plant effluent. (Bender et al. 1983.) The sewage treatment plant was also a major source of phosphous.

There was no significant difference in either species composition or population size of fish collected at SIUC Stations upstream from Champaign-Urbana or downstream of the urban areas and the sewage treatment plant. The majority of the species present belong to groups that are most tolerant of water quality and habitat degradation. It may be inappropriate to use fish in this stream system as biological monitors for urban stormwater. It is suggested that large scale habitat destruction by channelization and other physical constraints such as stream size and dissolved oxygen are the limiting factors in fish distribution in the Saline Branch Drainage Ditch as opposed to urban runoff.

The fish data collected by the IEPA and IDOC has to be viewed more cautiously. Data was collected at NURP Sites 1 and 5. Data collected at NURP Site 1, which is between SIUC Sites 1 and 2, was very similar to the SIUC data. Data collected at Site 5 downstream from the sewage treatment plant had a comparable total number of fish, but species diversity was substantially less with Pimephales notatus (bluntnose minnow) comprising 89% of the population. Since SIUC Sites 3 and 7 are also downstream from the sewage treatment plant and there were no significant differences in diversity at the SIUC sites one tends to conclude that habitat is the

significant factor in the species composition at NURP Site 5. NURP Site 5 is generally shallower and has a more rapid flow than the other sites. In addition it has a gravel bed as opposed to a predominance of sand bottoms at the other NURP sites.

Both IEPA and SIUC macroinvertebrate data indicated differences in the populations at the various sites. The SIUC data indicated no significant differences in total number of macroinvertebrates upstream or downstream from the Champaign-Urbana Sanitary District STP. However species composition did vary between stations. SIUC Site 3 which is .3 Km downstream from the sewage treatment plant had a significantly larger portion of Orthocladinae (midges) than did all the other sites.

If one examines the composition by percent of Ephemeroptera, Oligochaeta, Planariidae, and Diptera the trends become more obvious, Ephemeroptera (mayflies) are proportionately more prevalent upstream of both the urban area and the treatment plant than downstream. Ephemeroptera comprise less than 10% of the population at SIUC Sites 3 and 5, 0.3 and 3.8 Km downstream from the treatment plant. Some recovery begins at Sites 6 and 7 10.1 and 12.6 Km downstream from the treatment plant. Oligochetes show the opposite trend with relative abundance being less than 5% upstream from the urban area and over 50% at some sites downstream from the plant. This data suggests that the organic pollution from the sewage treatment plant is having a direct effect on the populations observed. A slight increase in tolerant species can be observed as one moves further from the treatment plant. However this recovery is not consistant from station to station or from species to species.

The effect that urban runoff is having on the macroinvertebrate population cannot be determined from the SIUC data. It is evident however that the treatment plant effluent is affecting species diversity. The NURP macroinvertebrate sample collected on 10/28/81 and 10/29/81 tends to confirm the SIUC data and gives further information on the urban effect. The NURP data indicates that there is a good species diversity at the control site (NURP Site 1); the percentage of intolerant species is 41% vs. 12.8% tolerant species. NURP Site 5 which is downstream from the plant has a tendency toward more tolerant species such as Oligochaetes and Chironomides and the more pollution tolerant species of mayflies. The pollution sensitive species of Ephemeroptera (mayfly) are not present and all Plecoptera have disappeared downstream from the sewage treatment plant. Stenacron interpunctatum has displaced other sensitive Ephemeroptera (mayflies) and Plecoptera (stoneflys) which have disappeared. Habitat factors may also be contributing to this distribution. NURP Site 5 has more rapid flow than other sites and a gravel bottom which is the habitat to which Stenacron interpunctatum is adapted. The increased number of tolerant organisms may be the result of increased nutrient loading from the STP.

NURP Site 4 is located downstream from the urban inflow but upstream from the sewage treatment plant and subsequently is a better indicator of the urban effect. Species diversity at NURP Site 4 is virtually identical to

the control site. The most pollutant sensitive species of Plecoptera (stone flies) have disappeared and the percentage of intolerant species has decreased to 9.5%. The largest increase in numbers between NURP Site 1 and NURP Site 4 is the species Stenacron interpunctatum a relatively tolerant mayfly. The urban influence is evident at NURP Site 4 with Physa sp. composing a substantial portion of the population. The proximity of this Site to Boneyard Creek where snails predominate has probably resulted in the large number of snails which may then displace other organisms. It is apparent that the urban area is having an impact on the species composition of the stream. The ambient water quality concentrations are intermediate between the control site and Boneyard Creek values indicating that Boneyard Creek is to some extent affecting water quality and possibly the biota. Storm water quality values are also elevated upstream from the control site and may be impacting population trends. One can not determine the extent to which urban runoff is affecting the population. However, the largest water quality impact in the Saline Branch Drainage Ditch is from the STP. It seems likely that this point source is the largest factor affecting macroinvertebrate populations in the Saline Branch Drainage Ditch.

Sampling during the dry weather conditions in Boneyard Creek indicates that this urban and completely modified stream is being affected by urban factors. Both species diversity and total number of macroinvertebrates is drastically less than at any station on the Saline Branch Drainage Ditch. Ninety-five percent of the organisms at NURP Site 2 and 98% of the organisms at NURP Site 3 are Physa sp., Oligochaeta, or Chironomidae which are the most pollution tolerant of all species. Several factors including D.O. ambient water quality, storm water quality and storm water quantity may be among the factors causing the low species diversity and total numbers at NURP Sites 2 and 3.

The D.O. at NURP Site 3 drops to a low of 1.5 mg/l at night which is stressful to aquatic life. It is noted that Stenacron interputatum which begins showing oxygen stress at 2.0 mg/l (Wiley et al. 1982) is absent at this site. This organism is prevalent at NURP Sites 4 and 5 which reach nightly D.O. lows of 3.8 mg/l and 2.5 mg/l and have sufficient flow to keep the D.O. above 2.0 mg/l.

The concentration of most water quality parameters during ambient flows are not significantly different at NURP Sites 2 and 3 than other NURP stations. Only Sulfate and Chromium values are higher than those found at NURP Site 5 which has a larger macroinvertebrate population than any other site.

Fresh water algae are very sensitive to hexavalent chromium. Reduction in growth in green algae can occur at as little as 10 ug/l. Diatoms have a 50% reduction in growth at 245 ug/l in soft water and 335 ug/l in hard water (USEPA 1980). Average dry weather flow concentration of total chromium is 59 ug/l (.059 mg/l) at NURP Site 3. The level of algal growth at NURP Site 3 is significantly lower than expected, with chlorophyll *a* concentrations being 1.92 ug/l and chlorophyll *b* levels

being 0.33 ug/l, indicating extremely low levels of both green and blue green algae. Chlorophyll data indicates that chromium may be one factor inhibiting algal growth which may then impact the macroinvertebrate populations. There was virtually no filamentous algae present at this site or any algae encrusted on rocks. The LC50 hexavalent chromium for fish and macroinvertebrate is substantially higher than for algae. Thus it appears unlikely that the depauperate macroinvertebrate population reflects a toxic affect from chromium.

Several metals (lead, copper and chromium) have values, during 85-100% of the storm events that greatly exceed the value promulgated by USEPA for a healthy aquatic community (USEPA 1980). These values are substantially higher than the 24 hour values that should not be exceeded. It is conceivable that these parameters may be having a toxic effect on the algae in Boneyard Creek and in some cases on the more sensitive macroinvertebrates, although toxicity thresholds for the macroinvertebrates tend to be higher than for the algae.

During storm events the mean flow velocity in Boneyard Creek is rapid with a mean peak flow of 180 cfs which sometimes exceeds. 550 CFS versus an average mean flow of 7.5 cfs at NURP Site 3 (Table 16). It is suspected that the flushing and scouring effects of an event as well as limited habitat may render this site uninhabitable by most organisms. While urban storm water quality may have some effect on macroinvertebrate populations in Boneyard Creek and the Saline Branch Drainage Ditch it is not the only factor affecting distribution and its relative impact is probably less than other factors such as point sources, stormwater quantity, habitat and dissolved oxygen levels.

Summary

1. Data collected did not indicate that urban runoff effects the species diversity or number of fish in the Saline Branch Drainage Ditch.

2. Macroinvertebrate diversity and species composition are significantly different upstream of and within the urban area than downstream of the urban areas, however, the extent to which urban runoff causes these differences cannot be determined from data collected in the present study. The study indicates that the Urbana-Champaign Northeast STP may have the largest impact on macroinvertebrate populations in the Saline Branch Drainage Ditch.

3. Ephemeroptera (mayflies) and Plecoptera (stoneflies) are most prevalent at NURP Site 1 located upstream from the urban area. There is a spatial shift toward more pollution tolerant macroinvertebrate species at NURP Site 4 which is downstream from the urban area but upstream from the sewage treatment plant. However, there are still several species of moderately pollution tolerant Ephemeroptera (mayflies) and other modification tolerant insect species. Snails which dominate Boneyard Creek sites comprise approximately 14% of the population at Site 4 indicating an urban influence. The largest shift in the numbers and types of macroinvertebrates occured at NURP Site 5 which is located downstream from the sewage treatment plant. There is a dramatic shift towards Annelids and Stenacron interpunctatum at this site.

4. Diversity and number of macroinvertebrates were the lowest in the totally urban Boneyard Creek where 95% and 98% of the organisms at NURP Sites 2 and 3 were the Physa sp., Oligochaeta or Chironomidae. Water quality, lack of habitat, low algae levels and nightly D.O. levels probably all contribute to this paucity. Storm water may be aggrevating the situation due to toxic level of heavy metals and scouring resulting from the large quantities of water passed during storm events.

5. High concentrations of total chromium in both ambient and wet weather flows may be the cause of low algal growth at NURP Site 3 in Boneyard Creek. High values of additional heavy metals in the storm water flows may also be contributing to low algal populations.

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Appendix I

Field Data Collected 9/8-9/9/83.

(Dissolved Oxygen, Water Temperature,
Air Temperature, Conductivity and pH)

Site	Time Started	Air Temperature	Water Temperature	Dissolved Oxygen	Conductivity	pH	Time Finished
1	2202	18.3	21.4	5.8	657	7.4	2206
1	0001	17.2	20.3	4.6	663	7.4	0013
1	0225	16.2	19.4	4.2	578	7.3	0229
1	0413	15.5	18.6	3.8	584	7.2	0417
1	0610	17.3	18.0	3.7	591	7.1	0615
1	0817	18.1	18.1	4.4	616	7.1	0819
1	1010	19.9	20.3	9.3	601	7.7	1018
1	1157	24	25.1	16.6	583	7.9	1209
1	1402	27.6	27.0	20.4	553	8.2	1404
1	1600	26.5	26.7	22.0	545	8.3	1609
1	1813	25.0	25.0	17.4	585	8.1	1816
1	2014	22.7	22.7	11.9	615	7.7	2019

Site	Time Started	Air Temperature	Water Temperature	Dissolved Oxygen	Conductivity	pH	Time Finished
3	2325	18.3	18.7	1.5	830	6.8	2331
3	0118	17.9	18.7	1.7	827	6.9	0123
3	0321	17.4	17.9	2.2	736	6.8	0331
3	0519	16.7	17.4	2.2	960	6.9	0524
3	0611	16.6	17.5	2.5	949	6.7	0617
3	0908	18.1	18.0	3.5	768	7.0	0911
3	1104	20.4	19.1	5.4	726	6.9	1106
3	1248	22.8	20.4	6.2	712	6.9	1250
3	1444	22.9	20.5	6.6	1180	7.0	1450
3	1701	23.6	20.9	5.3	739	7.0	1705
3	1929	23.6	20.4	2.3	1067	6.7	1933
3	2058	20.3	19.9	1.7	746	6.7	2109

Site	Time Started	Air Temperature	Water Temperature	Dissolved Oxygen	Conductivity	pH	Time Finished
5	2241	16.6	22.4	3.1	709	7.1	2243
5	0032	16.6	21.2	2.8	928	7.3	0039
5	0250	15.1	20.5	2.8	515	6.9	0259
5	0485	16.4	20.0	2.8	824	6.8	0441
5	0630	16.8	19.6	2.7	829	6.9	0635
5	0837	18.5	20.0	4.9	835	7.2	0839
5	1032	20.2	21.6	8.3	829	7.2	1035
5	1223	22.8	23.4	10.7	819	7.3	1225
5	1418	24.0	24.1	11.8	814	7.3	1420
5	1623	24.4	24.6	11.6	820	7.4	1625
5	1849	24.9	24.7	7.6	837	7.1	1852
5	2039	22.7	23.8	4.7	846	6.9	2039

Appendix II

Field Data for Stream Habitat Transects

WBC:bv/sp/8871C/1-56

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

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Stream Saline Branch Drainage Ditch Date 9/28/82

Station No. 1 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 1 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	0	0	0	9
2	2.0	2.0	0.50	.081	1
3	4.0	2.0	0.70	.081	1
4	6.0	2.0	0.95	0	2
5	8.0	2.0	1.00	0	2
6	10.0	2.0	1.00	0	2
7	12.0	2.0	1.10	0	2
8	14.0	2.0	1.2	.081	2
9	16.0	2.0	1.2	0	3
10	18.0	2.0	1.1	0	2
11	20.0	2.0	1.1	0	2
12	22.0	2.0	1.1	.081	2
13	24.0	2.0	.85	0	2
14	26	0	0	0	7
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 26 Channel width: _____

Comments: _____

TRANSECT NO. 2 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	0	0	0	7
2	2.0	2.0	0.35	0	2
3	4.0	2.0	0.60	0	2
4	6.0	2.0	0.50	0	2
5	8.0	2.0	0.55	0	2
6	10.0	2.0	0.60	0	2
7	12.0	2.0	0.80	0	2
8	14.0	2.0	0.10	.081	3
9	16.0	2.0	1.05	0	3
10	18.0	2.0	1.10	0	3
11	20.0	2.0	1.20	0	3
12	22.0	2.0	1.10	0	4
13	24.0	2.0	0.80	0	2
14	25	0	0	0	7
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 26 Channel width: _____

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	<.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

Stream Saline Branch Drainage Ditch Date 9/28/82

Station No. 1 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 3 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	0	0	0	9
2	2.0	2.0	.45	0	2
3	4.0	2.0	.50	0	2
4	6.0	2.0	.20	0	2
5	8.0	2.0	.90	0	2
6	10.0	2.0	.80	0	2
7	12.0	2.0	.95	0	2
8	14.0	2.0	1.0	0	2
9	16.0	2.0	1.1	0	2
10	18.0	2.0	0.90	0	2
11	20.0	2.0	1.2	0	4
12	22.0	2.0	0.55	0.081	2
13	24.0	0	0	0	0
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 24 Channel width: _____

Comments: _____

TRANSECT NO. 4 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrat bottom type
1	0	0	0	0	9
2	2.0	2.0	0.80	.081	2
3	4.0	2.0	0.80	.081	2
4	6.0	2.0	0.90	.081	2
5	8.0	2.0	0.90	.081	4
6	10.0	2.0	1.00	0	4
7	12.0	2.0	0.90	0	4
8	14.0	2.0	0.80	0	4
9	16.0	2.0	0.90	0	3
10	18.0	2.0	0.85	0	3
11	20	0	0	0	0
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 20 Channel width: _____

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	<.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

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Stream Saline Branch Drainage Ditch Date 9/28/84

Station No. 1 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 5 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	0	0	0	10
2	2.0	2.0	.80	0	2
3	4.0	2.0	.90	0	2
4	6.0	2.0	.75	0	2
5	8.0	2.0	.80	0	3
6	10.0	2.0	.80	0	3
7	12.0	2.0	.90	0	3
8	14.0	2.0	.90	0	3
9	16.0	2.0	.85	0	3
10	18.0	2.0	.80	0	3
11	20.0	2.0	.70	0	2
12	22.0	0	0	0	0
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 22 Channel width: _____

Comments: _____

TRANSECT NO. 6 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	0	0	0	1
2	2.0	2.0	.5	0	2
3	4.0	2.0	.5	0	2
4	6.0	2.0	.6	0	2
5	8.0	2.0	.75	0	3
6	10.0	2.0	.85	0	3
7	12.0	2.0	1.05	0	3
8	14.0	2.0	1.3	0	3
9	16.0	2.0	1.35	0	4
10	18.0	2.0	1.05	0	3
11	20.0	2.0	1.00	0	3
12	22.0	0	0	0	9
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 22 Channel width: _____

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	<.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

Stream Saline Branch Drainage Ditch Date 9/28/84

Station No. 1 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 7 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	1.0	0	0	1
2	2.0	2.0	.5	.081	2
3	4.0	2.0	.25	0	2
4	6.0	2.0	.25	0	2
5	8.0	2.0	.30	.081	2
6	10.0	2.0	.50	.081	2
7	12.0	2.0	.60	0	3
8	14.0	2.0	.85	0	3
9	16.0	2.0	.90	0	3
10	18.0	2.0	.80	0	3
11	20.0	2.0	.70	.081	3
12	22.0	2.0	.55	.081	3
13	24.0	2.0	0	0	7
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 24 Channel width: _____

Comments: _____

TRANSECT NO. 8 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☒

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	1.0	0	0	1
2	2.0	2.0	.20	0	2
3	4.0	2.0	.40	0	2
4	6.0	2.0	.35	0	2
5	8.0	2.0	.55	.091	2
6	10	2.0	.60	0	2
7	12	2.0	.75	.081	2
8	14	2.0	.90	.081	2
9	16.0	2.0	.90	.141	3
10	18	2.0	1.10	.081	3
11	20	2.0	0.9	0	3
12	22	2.0	0.70	0	3
13	24	2.0	0.50	0	2
14	25	1.0	0	0	9
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: 25 Channel width: _____

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	<.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

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Stream Saline Branch Drainage Ditch Date 9/28/84

Station No. 5 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 1 OF 8

Habitat type (check)

Riffle ☐ Run ☒ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	2.0	0	0	7
2	4.0	4.0	0.2	.216	3
3	8.0	4.0	0.40	.415	3
4	12.0	4.0	0.70	1.01	3
5	16.0	4.0	0.80	1.01	3
6	20.0	4.0	0.85	1.01	3
7	24.0	4.0	0.90	1.01	3
8	28.0	4.0	0.95	1.14	2
9	32.0	4.0	0.75	1.09	3
10	36.0	4.0	0.70	.486	3
11	40.0	4.0	0.40	.528	3
12	44.0	4.0	0	0	7
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

TRANSECT NO. 2 OF 8

Habitat type (check)

Riffle ☐ Run ☒ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0.0	2.0	0	0	3
2	4.0	4.0	0.6	0.439	3
3	8.0	4.0	0.70	0.520	3
4	12.0	4.0	0.75	0.764	3
5	16.0	4.0	0.80	0.812	3
6	20.0	4.0	0.95	1.01	3
7	24.0	4.0	1.0	1.05	3
8	28.0	4.0	1.05	1.12	2
9	32.0	4.0	1.1	1.01	3
10	36.0	4.0	0.90	0	3
11	40.0	4.0	0.50	0	1
12	44	4.0	0	0	7
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	<.002 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

Stream Saline Branch Drainage Ditch Date 9/28/84

Station No. 5 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 3 OF 8

Habitat type (check)

Riffle ☐ Run ☒ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	2.0	0	0	9
2	4.0	4.0	0.15	0	3
3	8.0	4.0	0.40	0.155	3
4	12.0	4.0	0.7	1.14	3
5	16.0	4.0	0.70	1.01	3
6	20.0	4.0	1.0	1.19	3
7	24.0	4.0	0.95	1.19	3
8	28.0	4.0	1.0	1.33	3
9	32.0	4.0	1.05	.33	3
10	36.0	4.0	0.80	0.358	2
11	40.0	4.0	0.60	0	3
12	44.0	4.0	0	0	7
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

TRANSECT NO. 4 OF 8

Habitat type (check)

Riffle ☐ Run ☒ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate bottom type
1	0	2.0	0	0	5
2	4.0	4.0	0.7	.574	3
3	8.0	4.0	0.6	1.08	3
4	12.0	4.0	0.7	.899	3
5	16.0	4.0	0.7	1.16	3
6	20.0	4.0	0.8	.845	3
7	24.0	4.0	0.90	.984	3
8	28.0	4.0	1.0	1.17	2
9	32.0	4.0	1.1	0.984	2
10	36.0	4.0	1.2	0.374	3
11	40.0	2.5	0.4	0	3
12	41.0	0.5	0	0	7
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	<.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

Stream Saline Branch Drainage Ditch Date 9/28/84

Station No. 5 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 5 OF 8

Habitat type (check)

Riffle ☐ Run ☒ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	2.0	0	0	7
2	4.0	4.0	0.7	.141	3
3	8.0	4.0	0.8	.476	3
4	12.0	4.0	0.9	.574	3
5	16.0	4.0	0.9	.880	3
6	20.0	4.0	0.9	.764	3
7	24.0	4.0	0.9	1.01	3
8	28.0	4.0	0.9	1.25	3
9	32.0	4.0	1.1	1.25	2
10	36.0	4.0	1.0	1.28	3
11	40.0	4.0	0.85	.683	4
12	44.0	4.0	0.4	0	4
13	48.0	4.0	0	0	7
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

TRANSECT NO. 6 OF 8

Habitat type (check)

Riffle ☐ Run ☒ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	2.0	0	0	9
2	4	4.0	0.55	.276	3
3	8	4.0	1.1	.228	3
4	12	4.0	1.15	.439	3
5	16	4.0	1.1	.683	3
6	20	4.0	1.05	.845	3
7	24	4.0	1.1	.520	3
8	28	4.0	1.1	0	2
9	32	4.0	1.1	1.01	2
10	36	4.0	1.0	1.09	3
11	40	4.0	1.0	.423	3
12	43	3.0	0	0	7
13					
14					
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16					
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21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

HABITAT DIVERSITY FIELD SHEET

Stream Saline Branch Drainage Ditch Date 9/28/84

Station No. 5 (NURP) Field Crew Davis/Pendowski

TRANSECT NO. 7 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☒ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	2.0	0	0	9
2	4.0	4.0	0.5	0	4
3	8.0	4.0	0.80	.139	4
4	12.0	4.0	1.15	.408	4
5	16.0	4.0	1.2	.106	3
6	20.0	4.0	1.3	.683	8
7	24.0	4.0	0.8	1.14	3
8	28.0	4.0	1.2	1.39	2
9	32.0	4.0	1.2	1.33	3
10	35.0	4.0	0.9	0.683	4
11	40.0	4.0	0	0	7
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

TRANSECT NO. 8 OF 8

Habitat type (check)

Riffle ☐ Run ☐ Riffle-Run ☐ Pool ☐

Point No.	Distance from water edge (ft)	Increment width (ft)	Depth (ft)	Velocity (ft/sec)	Substrate-bottom type
1	0	2.0	0	0	9
2	4	4.0	.60	0	4
3	8	4.0	1.0	0	4
4	12	4.0	0.8	.497	3
5	16	4.0	0.75	.245	3
6	20	4.0	0.70	.228	3
7	24	4.0	.8	.457	3
8	28	4.0	0.95	1.49	3
9	32	4.0	1.1	1.39	3
10	36	4.0	1.1	1.46	3
11	40	4.0	0.75	1.66	3
12	43	2.0	0	0	7
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

Mean depth and velocity: _____ _____

Water width: _____ Channel width: 55

Comments: _____

Code	Substrate	Particle Size	
1	Silt-mud	.062 mm	
2	Sand	.062 - 2 mm	
3	Gravel	2 - 64 mm	(.08-2.5 inches)
4	Rubble	64 - 250 mm	(2.5 - 9.8 inches)
5	Boulder	250 - 4000 mm	(>9.8 inches)
6	Bedrock	Solid rock	

Code	Bottom Type
7	Claypan - compacted soil
8	Plant detritus
9	Vegetation
10	Submerged logs
11	Other _____

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